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## DOMESTIC TRENDS TO THE YEAR 2015 FORECASTS FOR THE UNITED STATES

Demography  
The Economy  
Resources  
Education  
Society  
Technology  
Military Science  
Geopolitic and Threat

*A Report Prepared under an Interagency Agreement  
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July 1991

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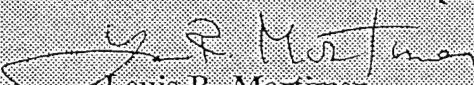
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## ACKNOWLEDGMENTS

The study you are about to read is the product of many analysts' research and study. Those analysts are identified as authors of the respective papers constituting the work. This project concerns the prediction of future United States domestic trends to the year 2015. It has offered everyone an opportunity to think creatively and project into the future. While this is a difficult task, it is nevertheless exciting and challenging. We have all learned and profited from the experience.

A product of this magnitude cannot be accomplished without the assistance of many other talented people who are not identified elsewhere. The Federal Research Division of the Library of Congress has many such talented people and the editor would like to take this opportunity to thank them for their many hours of hard work and assistance. First, to David Cabitto, our graphics artist, for his skill in compiling the many excellent charts and graphs. The graphics add much to the clarity of the text. Next, to Marilyn Majeska and her staff, for reading the manuscript and making valuable suggestions. Her skilled eye and careful reading are greatly appreciated for making the text more lucid and precise. We gratefully acknowledge the people who helped with the inevitable complexities of automation, Steven Cranton and Sara Arason. Our work was saved on more than one occasion through their efforts.

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## INTRODUCTION

It is abundantly clear to most researchers that the United States and the developed world are well into a period of transition that is generating a great deal of turbulence, both domestically and globally. Technology is transforming virtually every aspect of world society and effecting changes in developmental trends. While it is impossible to predict the future with any certainty, it is altogether appropriate for the U.S. Army to be concerned with future studies and forecasting.

Twenty-five years ago the United States was coming to grips with the Civil Rights Act of 1964. The population was predominantly white and the principal minority group was black, constituting approximately 10 percent of the total. The percentages of the Asian and Hispanic populations were far lower. The American economy towered over all others in the world. The dollar denominated all international trade, domestic oil production met most of the nation's needs, and American schools were seeing the results of the science and mathematics curriculum instituted as a result of the launching of Sputnik in 1957. Although the debate about the involvement in Vietnam was becoming increasingly strident, there was no "Vietnam syndrome" because no one would know the outcome of the conflict for nine more years and much more time would pass before Americans would formulate any general opinion about it. In fact, in 1966 the United States was well into the federal effort aimed at creating the "Great Society." Many of the nation's citizens believed America could have both guns and butter: the greatest military machine and the greatest social reform effort the world had ever seen.

During this time the international system was well defined and predicated on the bi-polar confrontation between the two power blocs that had emerged from World War II: NATO and the Warsaw Pact. The superpowers focused on Europe and, although the Cuban crisis of 1963 briefly had raised the threat of escalation, the two forces, in the main, contested each other in remote areas of the world through their client-states or proxies.

In 1966 the concept of "personal computing" was unknown because automation technology meant the mainframe computer and "dumb" terminals. "Smart" bombs and laser-guided weapons were still in the idea stage, and planners would only forecast their use in the inevitable conflict with the USSR.

In 1966 the futurists had their visions, but many visions remain just that. In 1991 Americans are not commuting to work with jet packs strapped to their backs. People still drive automobiles, much to the detriment of the environment. Cities have not been encapsulated under domes, and electricity generated in nuclear power plants is not free of charge. The great social reform experiment has been re-evaluated and many Americans have mixed feelings about the Vietnam experience. The Cold War may have ended, not through superpower warfare, but because of the seeming collapse of communism from its own "inner contradictions." Yet the world still does not live in peace and harmony. What happened? Palmistry artists notwithstanding, no one can predict the future. Humans are limited to analyzing events and identifying trends so that they can be prepared for the future and not be too surprised at what takes place.

The task in this project has been to identify United States domestic trends for the next 25-year period, up to the year 2015, in the following areas: demography, the economy, resources, education,

society, technology, military science and geopolitics and threat. Scenarios have been constructed with potential variations for future developments in these areas. Analysts have identified those factors, the "change drivers," that will accelerate or retard the development of these trends, and have offered a range of possibilities to assist U.S. Army planners in future decision-making.

How has this been accomplished? Many excellent methodologies exist for predicting future trends. When a ballistic missile is fired, its future course can be determined with great precision by using calculations. This predictive ability guides the aiming procedure of a mortar crew for the first shot. The spotter provides guidance for future actions, that is, correction for wind, equipment-based idiosyncrasies, etc., without casting any doubt whatsoever on the validity of the basic theoretical predictive formula.

The long-term future of the physical world may be equally predictable. Assuming the Big Bang is, in fact, a valid model of the universe, and reliable measurements have been made of the amount of matter in space so one knows whether it will collapse or expand forever, one can calculate with precision just when the universe will "recycle" with contraction because of gravitational attraction of the galaxies and calculate the time of the next Big Bang, or when the universe will reach a certain degree of cold-expanded "entropy death." Future measurements will either confirm one of these outcomes, or possibly suggest that the predictive model is wrong, with implications that a better predictive model may be possible if new measurements are taken.

The verifiability of the predictive model in the physical world has been so successful that researchers have naturally sought equally reliable methodologies for the prediction of social developments. Some have even become so pleased with results obtained so far that they have provided "objective methods" for the projection of future developments. Examples of such methods are Rand's Delphi technique, forecasting by analogy with physical and/or biological processes, and extrapolation of trends. There have been some attempts to construct quantified structural mathematical models (as described by J. P. Martino, for instance). These methods are frequently of considerable use, particularly when forecasting technological developments in a narrow area.

The fact remains, however, that the kind of sure prediction available for measurement of events in the physical sciences is not available for the social sciences, regardless of the sophistication of the statistical techniques used. The underlying basic processes in physics involve known, unambiguous, precisely described analytical formulas (like the gravitational equation that describes both the path of a projectile and the attraction of galaxies), while social scientists have no unambiguous testable mechanism. They must rely on correlations between events. In this case, trend extrapolation is a valid technique, as long as forecasters remember that the reasons behind a trend may be murky and that therefore the trend may cease for reasons that are not, in principle, unpredictable, but which have not yet been identified. Unless they recognize this fact, forecasters may easily misinterpret the degree of validity the trend projection allows. Of course, everyone wants to predict events with maximum validity, but caution must be exercised so as not to fall prey to mechanical procedures that sound scientific but do not, in fact, increase the validity of predictions.

The approach to the issue of methodology used here, given the breadth of the task (forecasting

essentially the whole social and technological set of changing conditions in the United States within the environment of global change) and the 25-year time frame, given the broad range of outlooks and orientations of the analysts, has been to embrace what psychologists call "construct validity." This approach involves specifying the explicit process assumptions for each argument as far as possible and allowing independent judgments to be made separately on all the arguments presented. Some of the arguments will necessarily be stronger than others, as dictated by available data and each writer's integrative vision. This approach also provides the sponsor with a clear understanding of each analyst's point of view and allows more accurate assessments to be made by the reader than would be possible if some mechanical "homogenization" technique were applied.

From the beginning of this project the researchers have believed these subject areas to be a loop of dependencies. The subjects interact with and depend on each other in ways that are, at once, clear yet obscure. What the United States is as a society depends greatly on what it comprises: the myriad of demographic facts that, when combined, tell us who we will be. This picture, in turn, will determine many trends in economic development. For example, an aging population provides a smaller manpower pool, hence the economy will either focus on fewer labor-intensive industries or increase the use of robots. An aging population also means that productivity will have to increase in order to satisfy the aging population's wants and needs. The demands of the economy in turn, will drive the natural resource base and requirements. If, for example, the United States is manufacturing products requiring rare earth minerals and raw materials unavailable domestically, there must be reliable foreign sources of supply. This fact means that the economy must be able to compete effectively in global markets, and, at the same time, the United States must be able to ensure that a regional power or powers will not choke off that supply.

Competing in a global economy will require a work force that is highly educated and trained in science and mathematics, has well-developed cognitive skills, takes individual initiative and is goal-oriented yet can work in groups to solve everyday workplace problems. The education system capable of producing graduates having these skills will demand a commitment from society. The values of that society, as exhibited through its social structure and relationships, will determine whether the education system will receive the attention it needs. If the product of education is equipped to compete globally, then society's economic surplus will increase and the wealth that accrues will enable the society's needs to be met. If society's children are well educated and competitive, then they will be able to create the technologies of tomorrow, use resources more efficiently and to the maximum benefit, and society's living standard will continue to improve. The military services are, in a sense, the ultimate consumer. The U.S. Army receives the product of education, the product of technological research and development, and the product of the economic riches of society. If these products are of high quality and in sufficient quantity, then the military services can provide for the society's security and meet any geopolitical crisis that may emerge.

By way of overview it shall be explained briefly how analysis has proceeded. Figures from the United States Bureau of the Census have been used. High and low projections for population growth in

2015 have been forecasted from these data, scenarios for future growth in racial groups, the distribution of age cohorts, potential regional population shifts, and possible immigration patterns have been mapped. The impact of infant mortality and disease on population trends have also been projected.

Analysis will show the effects of increasing globalization on the American economy and how this will affect the relationship of the manufacturing and service sectors. Global resource reserves and projected U.S. needs based on likely future technological developments will be studied. From these figures the steps needed to be taken to ensure adequate supplies of critical resources will be identified.

The education system will be investigated to determine current deficiencies and the trends emerging as potential solutions to problems widely acknowledged by educators and the public alike will be identified. Analysts will project possible scenarios for the likely success of education reforms.

American society will have a higher percentage of elderly people in 2015 than now. As a result, the available manpower pool for the military will be reduced and generational conflicts over pensions and benefits for retirees might possibly occur. The role women will play in the labor force and the military will be projected. Americans will continue to be idealistic and express strong religious beliefs and affiliations. While the United States will not be isolationist, it will not be the "world's policeman": U.S. forces will intervene if vital interests are at risk, but will do so as part of a coalition of forces.

The concept of technological development and the limits to technological change will be discussed. Americans will be in the forefront of technological creativity and innovation, but it is not certain that United States industry will lead in the manufacture of technological products.

The development of military science in light of changes in strategic thinking and the evolving system of international relationships will be forecast. Current U.S. security requirements and potential threats based on likely developments in the world system will be projected. The end of the Cold War does not mean "the end of history" but rather a different form of competition between rivals: economic domination. It remains to be seen whether economic power alone can define superpower status.

The United States will be challenged in many ways in the coming 25 years and the challenges will be met. Citizens of the United States have the creative talents and problem-solving skills to meet the tests that most certainly will emerge. It is to these forthcoming issues that this study now turns.

## **KEY JUDGMENTS**

### **DEMOGRAPHY**

- Based on the 1990 Census figures, the population of the United States in 2015 will reach 303.4 million.
- The nation will become more ethnically diverse, with 37.8 percent of the total population identifying itself as a member of a minority group. By 2015 Hispanic-Americans will be the largest minority (44.4 million), followed by Black-Americans (41.9 million) and Asian-Americans (13.3 million).
- Legal immigration will average 550,000 to 600,000 per year. The southern border of the United States will continue to be semi-permeable: economic conditions in Central and Latin America are not expected to improve markedly to stem the tide of migrants northward.
- Most of the national population growth will be attributed to ethnic minorities. In the 18-25 age cohort, the percentage of ethnic minorities will increase from 32.9 to 44.5. Recruitment tactics must improve to attract and retain minorities and specialized instruction will need to be intensified.
- By 2015 the median age of the population will be 37.6, up from the current 33. The ratio of those under age 18 will decline, while the ratio of those over age 65 will rise. Life expectancy at birth will be 81.5 years for women and 74.6 years for men.
- The 18-25 army recruitment cohort, currently 12 percent of the total population, will drop to 10.7 percent in 2015.
- The average army soldier will be over the age of 30, married with children or a single parent. This soldier will be the oldest in combat since the Civil War. The Army will be required to provide more social services because of the increasing number of women and single parents in active and reserve status.
- The trend toward urbanization will continue. More than half of the nation's total population resides in 39 large metropolitan areas. Two-thirds of the Hispanic population will be centered in 25 large metropolitan areas.
- The number of married-with-children households will continue to fall, and the number of single-parent households will rise, with the overwhelming majority of them headed by women.
- The effects of AIDS will persist through 2015, with between 1,500 and 2,000 HIV-positive babies to be born every year in the next 25 years. While a preventive vaccine is likely to be discovered in the forecast period, a cure for those already stricken is uncertain.

## DEMOGRAPHY OF THE UNITED STATES IN 2015

### INTRODUCTION

The population of the United States totalled 249,632,692 on April 1, according to the 1990 Census, and is expected to reach 303.4 million by July 1, 2015 (see Fig. 1). These figures are from the Bureau of the Census and are not completely reliable. On April 18, 1991 the Bureau announced an undercount of six million people in the 1990 census. This number is still being debated and undoubtedly will be subject to change in the future. Because these figures arrived as this study was in its final stages, the figures used herein are based on previously announced totals. It is imperative, therefore, that the reader understand that revised figures by the Census Bureau will skew various projected numbers accordingly. However, the trends identified through the analysis presented here are valid.

The population is multinational; this characteristic of the population will be more pronounced in 2015, when ethnic minorities will account for 37.8 percent of the total. Hispanics will be the dominant minority group. The country will be largely urban and more densely populated in the South and West than in the North and Midwest. The population in general is aging, pushing the median age in 2015 to 37.6 from the present 33.

Progress of medical science in the treatment of disease has contributed to the continuing increase in life expectancy from the present 72.1 for men and 78.9 for women to a projected 74.6 for men and 81.5 for women in 2015. Women will outnumber men by a ratio of 104 to 100.

The number of married-with-children households in the United States fell from 80.5 percent of the total in 1980 to 77.1 percent in 1988, while the number of single-parent households rose from 19.6 percent to 22.9 percent. Of the 7.3 million single parents in 1988, 6.3 million were women, 15.2 percent more than in 1980.

Single-parent households will continue to rise through the year 2015, but at a slower rate. Because the fear of AIDS has caused many people to reduce the number of their sexual partners, there has been a noticeable change in the divorce and marriage rates. After a steady rise in the 1970s, divorce rates have begun to decline. Marriage rates have declined since 1950, but the number of marriages has been constant. It is expected that the divorce rate will decline further and the number of marriages will increase.

The U.S. population projections in this study are based on Series 15, one of 30 series tabulated by the Bureau of the Census in its population projections for the period 1988-2080. Series 15, using a high fertility rate, reflects the birth surge of 1989 (see below). Illustrating the difficulty of accurately projecting population, Series 14, disseminated as the official projected population, was based on a medium fertility rate. By 1991, the number of children under five years of age in this series was at least 1.5 million fewer than the actual number in the cohort. Hispanic projections are based on Series 17, one of 30 projections for the Hispanic population from 1983 to 2080. This series took into account a high rate of immigration.

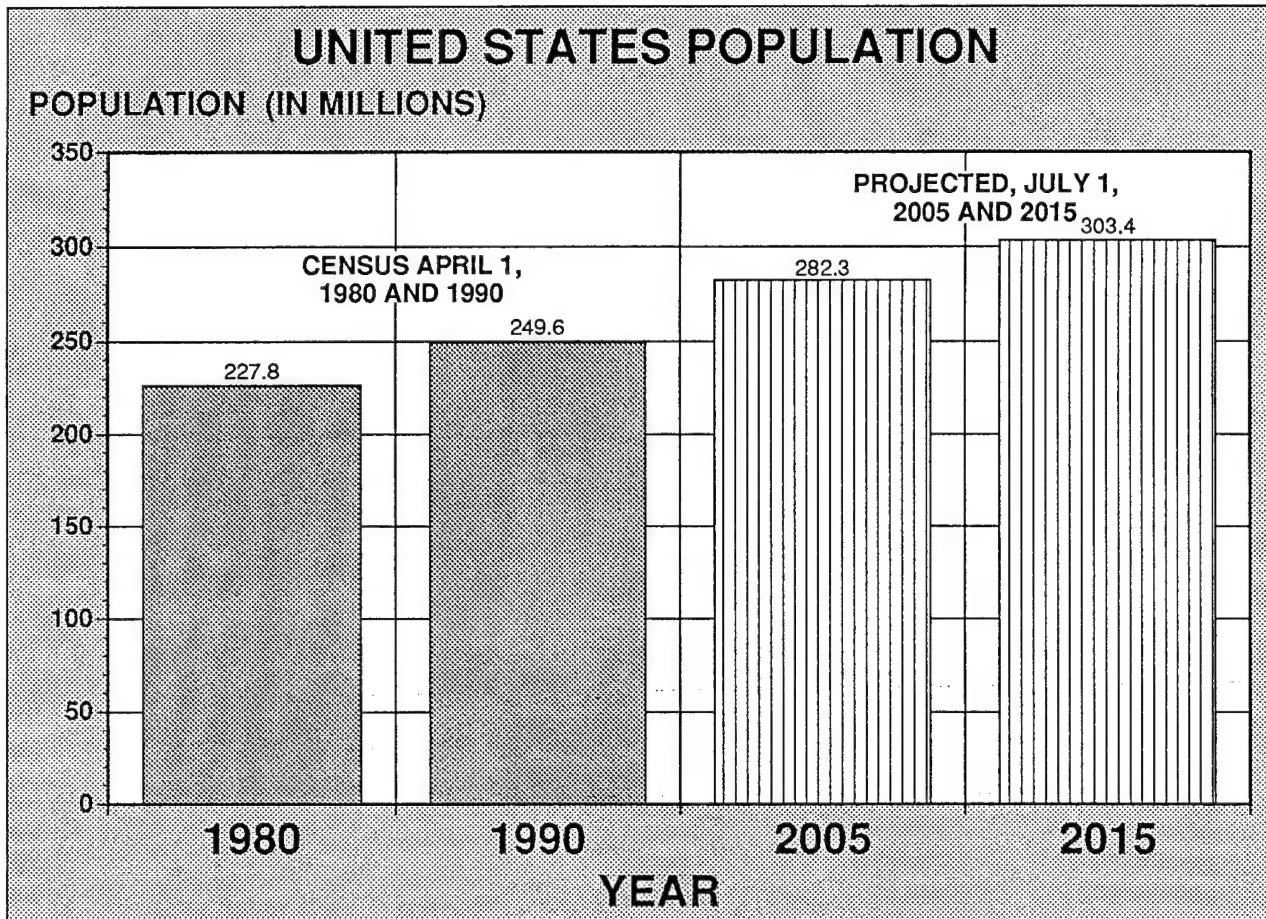


Fig. 1

## Population Trends and Projections

The U.S. population grew at an annual average rate of less than 1.0 percent during the last two census years, 1980 and 1990. This rate would have been even lower had it not been for the birth surge of 1989 and the legalization of a large group of originally illegal aliens. The average annual population growth rate was 1.9 percent during the decade 1950-60; then it sharply dropped in the following two decades to 1.3 percent (1960-70) and 1.1 percent (1970-80).

Through the analysis of projected Bureau of the Census figures, the U.S. population will reach 303.4 million by July 1, 2015, based on the following projections: (a) the birth surge of 1989 will slowly decline from about 16 per thousand to 14.4 in 2015; (b) the death rate will remain near the current level of 8.7 per thousand until the year 2000, then rise to 9.0 per thousand by the year 2015; (c) net immigration will begin at 600,000 per year in 1991 then diminish to 500,000 after 1998; and (d) the assumption that no unforeseen events will occur that often skew demographic projections, such as natural calamities, fatal epidemics, or a large influx of illegal immigrants and refugees. A change in one or more of these factors could shift the projected population from a high of 320.5 million to a low of 265.1 million in 2015 (see Table 1).

**Table 1. U.S. Population, Actual and Projected,  
Selected Years, 1980-2015<sup>1</sup>  
(in millions)**

	Actual <sup>2</sup>		Projected <sup>3</sup>	
	1980	1990	2005	2015
Population	227.8	249.6	n.a.	n.a.
Low Population	n.a.	n.a.	262.4	265.1
Medium Population	n.a.	n.a.	282.3	303.4
High Population	n.a.	n.a.	291.7	320.5

n.a. -- not applicable.

<sup>1</sup> Includes military and federal employees overseas.

<sup>2</sup> Census data; date of census is April 1.

<sup>3</sup> Date of projection is July 1.

## VITAL STATISTICS

### Births

At the height of the Baby Boom in the early 1960s, annual births peaked at nearly 4.3 million, fell to 3.1 million in the 1970s, then slowly rose again and surged in 1989 with over 4 million births. The increase in the number of births recorded in the late 1980's was partially attributed to the rise in teenage pregnancies, which had been in decline for the 25 years before 1986. About half-a-million teenage girls became single mothers in 1988; this number would have even higher had there not been 416,000 abortions and more than 120,000 miscarriages or stillbirths. Also contributing to the high number of births were the recent immigrants, especially Asians and Hispanics, who have a much higher fertility rate than white Americans. The high 1989 birth rate is not expected to be a continuing long-term rise. (see Fig. 2)

### Deaths

In 1988, a total of 2,167,999 deaths were recorded in the United States, 44,676 more than in 1987. This increase was attributed to the continued growth in the size of the population, an upward proportion of older people, and an influenza outbreak in 1988. Infant mortality was still high in 1990, with 9.1 per 1,000 births, down from 9.7 deaths in 1989. Each year nearly 40,000 infants die before reaching their first birthday; 10,000 of them could probably be saved through the early application of commonly known preventive measures. Nineteen large cities were identified as having an infant mortality rate higher than the national average for the five-year period from 1984 through 1988. The rates ranged from 21.1 per thousand in Washington, D.C. to 10.54 per thousand in Los Angeles. Many smaller cities with a population of 100,000 to 250,000 and many rural counties in Mississippi have an equally high rate of infant mortality.

The death rate is not expected to decrease sharply in the next 25 years unless extraordinary progress in medical science cuts the number of deaths caused by the current leading diseases of the United States. Among these are coronary heart disease, cerebrovascular disease, Alzheimers, and AIDS. Deaths attributed to these diseases accounted for 87 percent of those recorded in 1988. Even with forecasted improvements in medical care (including a vaccine and/or an affordable cure) and changed individual behavior, the death toll of AIDS is expected to be cut by a mere 10 percent over 10 years; it rose over 23 percent between 1987 and 1988. According to preliminary data, AIDS was the 11th leading cause of death in 1989. In 1988, AIDS ranked 15th. It is expected that AIDS will be among the top 10 leading causes of death in coming decades. According to the Center for Disease Control the current number of Americans suffering from virulent AIDS is about 172,000, and specialists there estimate approximately another million have been identified as HIV-positive. The Pan American Health Organization (PAHO) estimated that more than 3 million people in the Western Hemisphere will be infected with the AIDS

virus by the mid-1990s. In Haiti, one in ten pregnant women is infected with this virus. A new study published in the Journal of the American Medical Association indicates that in the United States about 80,000 women of child-bearing age may be HIV-positive. This figure means that between 1,500 to 2,000 babies could be born HIV-positive each year. The areas with the highest rates of infected women in the study were New York with 5.8 per thousand, the District of Columbia with 5.5, New Jersey with 4.9, and Florida with 4.5.

Some progress has been made in coping with this disease. Medical research has made rapid progress in identifying the virus and its replication apparatus. It is probable that a cure and/or a vaccine will be found in the forecast period. Other venereal diseases have shown a higher rate of incidence. Since 1986, syphilis cases nationally have almost doubled, with the largest increases occurring in low-income areas of major cities. National health experts have blamed much of the severe syphilis outbreak in urban centers on growing use of crack cocaine and prostitution. A dramatic drop in infection rates has recently been noted in a few states where an aggressive AIDS-prevention program has been enacted (for example, Colorado), leading some public health officials to conclude that the AIDS and syphilis efforts complement each other.

Teenage sexual activity rose sharply in the 1960s and 1970s. It declined slightly in the early 1980s, but increased again in the mid- and late 1980s despite the dissemination of much information about the ever present danger of HIV infection. According to the National Survey of Family Growth, 53 percent of all 15-to 19-year-old females were sexually active in 1988, up from 47 percent in 1982. More than 20 percent of all AIDS victims are in their twenties. Given the incubation period between initial HIV infection and the virulent onset of recognizable AIDS symptoms, most probably became infected as teenagers. In San Francisco alone, 10,000 AIDS victims were recorded on 14 February, 1991 and 10,058 at the end of the month, an increase of 58 in a scant 14 days. It is estimated that about 20,000 to 25,000 San Franciscans are HIV-positive. Studies indicate that up to 20 percent of the city's homosexual men between the ages of 16 to 24 are probably infected, an obvious danger sign of yet another wave of AIDS. In the Washington, D.C. area, the AIDS infection rate is also very high, averaging approximately 3.5 new AIDS cases per day. More than 3,000 have died since 1982, and 39,100 are believed to be HIV-positive. Other cities reporting higher numbers of AIDS cases are New York City (31,635), Los Angeles (11,409), Houston (5,086), Miami (4,633), Newark, New Jersey (4,571), Chicago (4,236), Philadelphia (3,597), and Atlanta (3526), all major metropolitan areas. The disease has a high incidence among intravenous drug users and their sexual partners, and children.

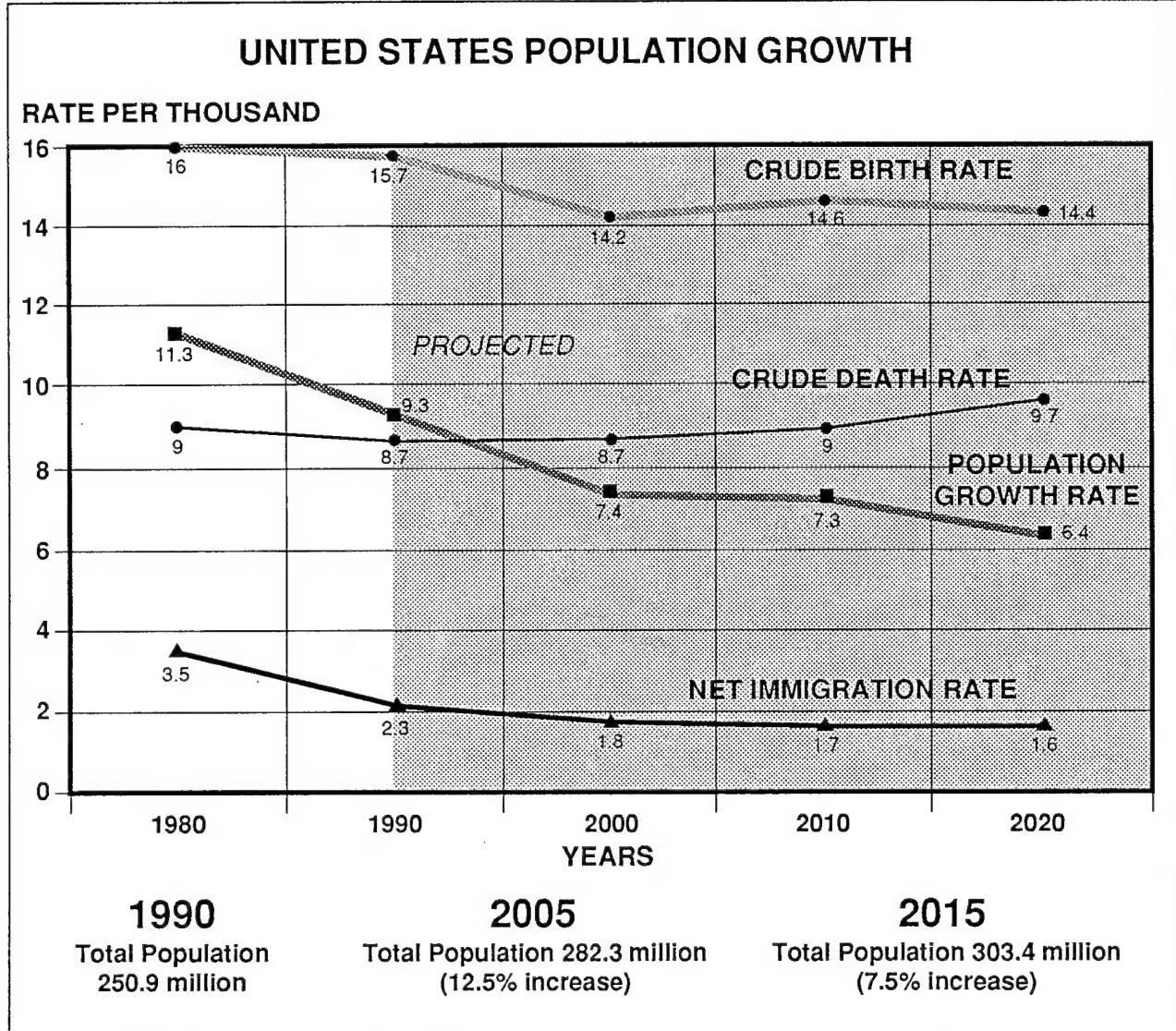


Fig. 2

## Immigration and Outmigration

Net immigration accounted for 40 percent of the population growth in the late 1800s but ebbed during the years of the great depression. In the past decade, the rate of net immigration accounted for 30 percent of the population growth because the United States represents widely publicized opportunities for freedom, jobs, and education to peoples around the world. This rate will likely increase as long as poverty and political instability in the countries of Central and South America and the Third World persevere. Most immigrants of the past two decades have been Asian and Hispanic rather than European, unlike earlier periods. More than 2.5 million illegal aliens were granted amnesty under the 1986 Immigration Reform and Control Act. A major change in the new U.S. Immigration Act of 1990, which becomes effective in October 1991, will tilt the balance more toward European applicants and away from Asians. The new bill emphasizes the admission of foreigners having professions and skills deemed necessary by the United States. It replaces the 1965 Hart-Cellar Act, which granted quotas on the basis of kinship with U.S. citizens or ties to its residents, rather than on country-of-origin. The 1990 bill emphasizing skills raises legal immigration from the current level of about 500,000 per year to 700,000 per year for the first three years, then to 675,000 thereafter. The number of visas granted on the basis of desired job skills will be almost three times the current 54,000, up to 140,000; family-sponsored visas will increase by a smaller margin, from the current 435,000 a year to 465,000 for the first three years and to 480,000 thereafter.

The number of emigrants from the United States has been around 100,000 a year. Most of these people returned to their original countries or sought other places with an equally desirable political climate or environment. It is projected that the emigrants will number between 100,000 to 160,000 a year.

## Age Distribution

Over the next two decades, the massive Baby Boom cohorts will all be over age 45, and the large number of babies born in the late 80s and early 90s will be below 30. This situation will effect a shift in the median age from 33.0 in 1990 to 37.6 in 2015. The dependency ratio, which indicates how many children and elderly people there will be for every 100 persons of working-age (18-65), reflects the change in the age structure (see Table 2). Large numbers of aging or youthful populations affect dependency relations within that population. The ratio of those under 18 is expected to continue to decline through the year 2015 and the ratio of those over 65 is expected to rise. It is projected that the ratio of dependents to the working-age population will be lower during the next 25 years than in earlier decades, going from 76.7 per hundred in 1960 to 61.8 in 2015. The dependency of the youthful population (17 years old and under) is expected to continue to decline from 62.8 per hundred in 1960 to 39.6 per hundred in 2015. Conversely, the elderly (over 66 years old) dependency ratio will continue to rise, from 13.9 per hundred in 1960 to 22.3 per hundred in 2015.

**Table 2. Dependency Ratio, Selected Years, 1960-2015**

Year	Dependents per 100 Workers*	Age 17 and Under	Age 66 and Over
1960	76.7	62.8	13.9
1970	73.2	58.5	14.7
1980	60.3	44.4	15.9
1990	59.8	41.1	18.7
2005	59.0	39.8	19.2
2015	61.8	39.5	22.3

\*Age 18 to 65 years.

The 18-to-25-year-old group--an important segment to colleges, the military, and employers--estimated to number 32.4 million in 2015, would be smaller if it were not for the unexpectedly high number of births of 1989. On the high projection, this group will reach over 34.0; on the low projection, less than 27.0 (see Table 3). The personal behavior of this group should be of interest to future military recruiters. Recent surveys show that college students' use of illicit drugs is at its lowest level in a decade, although marijuana, hallucinogens, and cocaine are still to be found on campuses. The University of Michigan's Institute for Social Research in a recent 1990 survey indicates that only

**Table 3. Recruitment-Age Population (18-25)  
by Type of Projection, 2005 and 2015  
(in thousands)**

Type of Projection	2005	2015
Low	29,756	26,973
Medium	30,720	32,408
High	31,884	34,043

15 percent of the students admitted having used an illegal drug in the past month, down from 38 percent of 1980. Seventy-five percent reported monthly alcohol consumption, also down from 80 percent of 1980. Accurate projections of future drug and alcohol use are mere guesses. If, as some social scientists believe, the United States is in the early stages of another temperance movement (two previous such temperance eras have been recorded, each lasting roughly 30 years), then alcohol and drug use could

decline even further in the forecast period. If illicit drug use does change significantly, then the American public may come to grips with this issue in another manner (see "Society").

Both age groups, those under 18 years old and those aged 18 to 65, are expected to decrease only slightly in 25 years, from 25.7 percent of the total population in 1990 to 24.5 percent in 2015 for the group under 18; and 62.6 percent of 1990 to 61.8 percent for the group aged 18 to 65. The number of the older, 66 years old or more, will increase from 11.7 percent in 1990 to 13.7 percent in 2015 because of the impact of the Baby Boom years (see Table 4). In 1990 there were almost 157 million people of working-age in the United States; they paid Social Security taxes for 29.4 million elderly, a ratio of 5.4 workers to 1 retiree. This ratio will decline in 25 years to 4.5 workers per retiree. In addition to increased pensions for retirees, Social Security will have to absorb rising medical costs. Retirement age will likely be extended to 70 in order to maintain system solvency. As life expectancy pushes close to 80 for men and over 80 for women, this is not an unrealistic projection.

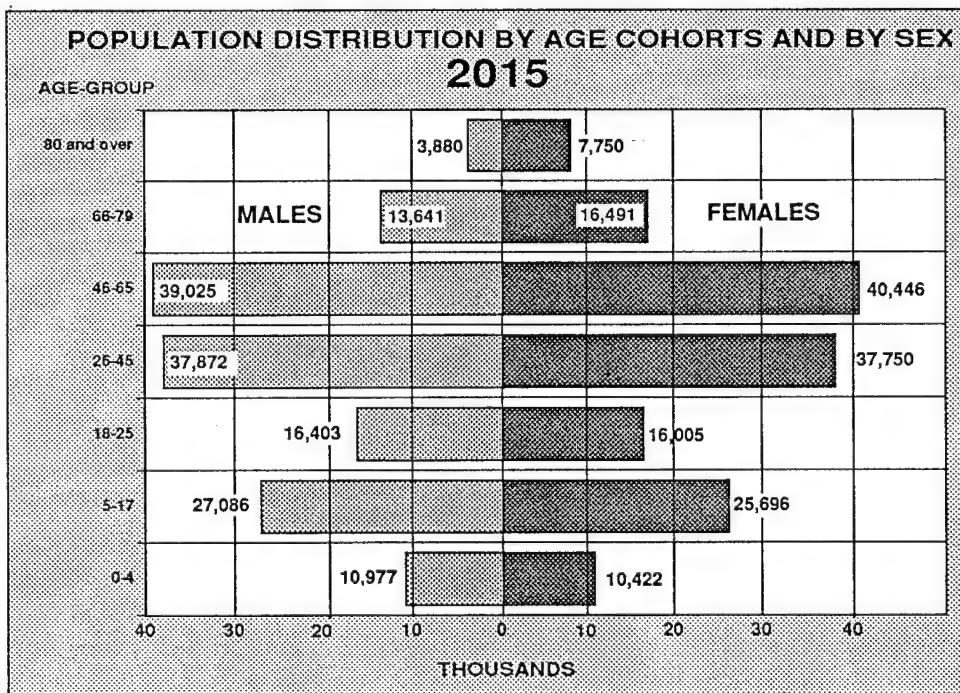
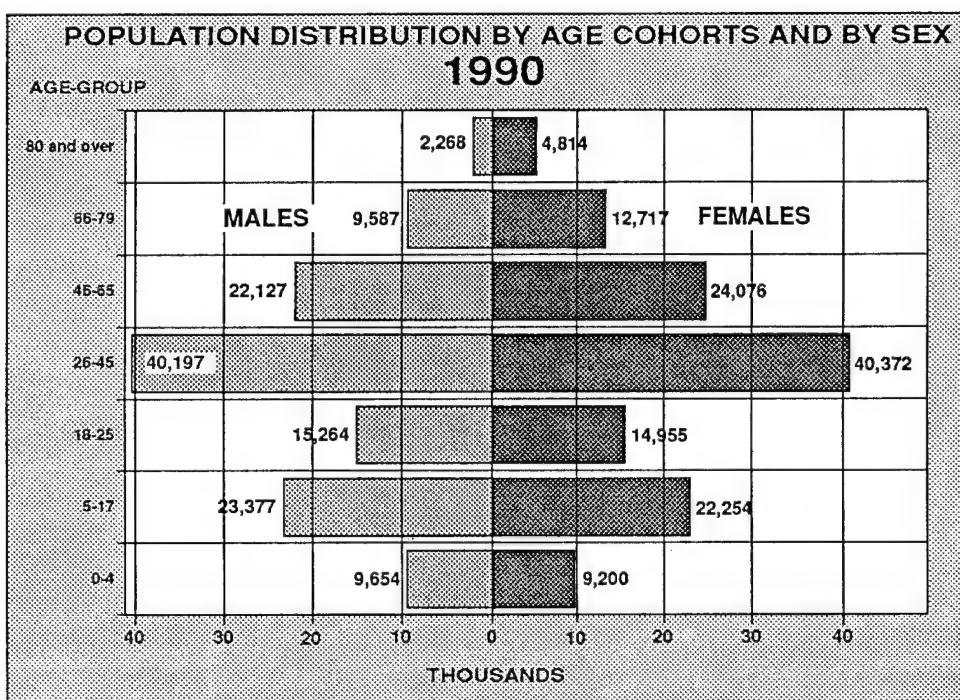
**Table 4. Population Distribution by Age Cohort,  
1990, 2005, and 2015**

Age Cohort	1990		2005		2015	
	Number*	%	Number*	%	Number*	%
0-4	18,854	7.5	19,309	6.8	21,399	7.1
5-17	45,631	18.2	51,415	18.2	52,782	17.4
18-25	30,219	12.1	30,720	10.9	32,408	10.7
26-45	80,569	32.1	77,570	27.5	75,622	24.9
46-65	46,203	18.4	69,233	24.5	79,471	26.2
66-79	22,304	8.9	23,466	8.3	30,132	9.9
80+	7,082	2.8	10,620	3.8	11,630	3.8
<b>TOTAL</b>	<b>250,862</b>	<b>100.0</b>	<b>282,333</b>	<b>100.0</b>	<b>303,444</b>	<b>100.0</b>

\*In thousands

Date of population is July 1.

Population distribution by age cohorts and by sex is shown in Table 5 and Figure 3.



**Fig. 3**

**Table 5. Population Distribution by Age Cohort and Sex,  
1990, 2005, and 2015  
(in thousands)**

Age Cohort	1990		2005		2015	
	Male	Female	Male	Female	Male	Female
0-4	9,654	9,200	9,901	9,408	10,977	10,422
5-17	23,377	22,254	26,373	25,042	27,086	25,696
18-25	15,264	14,955	15,538	15,182	16,403	16,005
26-45	40,197	40,372	38,840	38,730	37,872	37,750
46-65	22,127	24,076	33,777	35,456	39,025	40,446
66-79	9,587	12,717	10,368	13,098	13,641	16,491
80+	2,268	4,814	3,506	7,114	3,880	7,750
<b>TOTAL</b>	<b>122,474</b>	<b>128,388</b>	<b>138,303</b>	<b>144,030</b>	<b>148,884</b>	<b>154,560</b>

Date of population is July 1.

### Ethnic Composition

The Bureau of the Census does not give a separate breakdown for Hispanics; for statistical purposes Hispanics are forced to choose between white, black, or other on census forms. Therefore the current number for whites combines people of European background with Hispanics; the number for blacks includes people of African background and Hispanics; and the number for Others includes people of mixed-races and Hispanics, plus those who have not identified themselves as white, black, Hispanic, Asian, American Indian or Aleuts. For this study, an effort was made to separate Hispanics from the

whites, blacks, and others figures. All numbers pertaining to ethnics reflect this reconstruction.

**Table 6. Composition of Population by Ethnic Group,  
1990, 2005, 2015**

Ethnic Group	1990		2005		2015	
	Number*	%	Number*	%	Number*	%
White	180,250	71.8	187,436	66.4	190,702	62.8
Black	29,348	11.7	36,557	12.9	41,943	13.8
Hispanic	22,522	9.0	34,792	12.3	44,450	14.7
Asian	7,329	2.9	10,627	3.8	13,284	4.4
Indian	1,962	0.8	2,256	0.8	2,436	0.8
Other	9,451	3.8	10,665	3.8	10,629	3.5
<b>TOTAL</b>	<b>250,862</b>	<b>100.0</b>	<b>282,333</b>	<b>100.0</b>	<b>303,444</b>	<b>100.0</b>

\*In thousands

Date of population is July 1.

Table 6 shows the expected future changes in the ethnic composition of the U.S population resulting from the last two decades of heavy immigration: legal, illegal, refugee. These changes will require many program alterations in American institutions, such as education, labor, health and welfare, and the military. The majority of immigrants, seeking a haven and the golden opportunity of the United States (especially Hispanic and Asian illegal immigrants) are poor and often illiterate in their own language. On the positive side, immigrants frequently help accelerate the pace of American growth and development; on the negative side, they just as often arouse ethnic conflict and racial tensions. Periodically, certain groups of Americans set out to curtail the influx of immigrants, but the acknowledged need for more people, coupled with the well known commitment of America to be the land of the free and a haven for the distressed, prevents serious legislative curbs. The latest Immigration Act (1990) reflects this commitment. The government presently contemplates admitting entry to all, regardless of their health status, even those with serious contagious diseases, including AIDS. This policy is contrary to the old laws which prohibited entry of those considered to have less serious diseases, such as leprosy and tuberculosis.

Most of the future population growth in the United States will come from Asians, Hispanics and others. The two ethnic groups that have the largest number of kin-related people now in this country are Asians and Hispanics. Their fertility rates are generally higher than those of whites and their death rates are lower than those of blacks and whites.

In 2015, whites, excluding white-Hispanics, will represent 62.8 percent of the total population, down from 71.8 percent in 1990, while minorities will grow to 37.2 percent, up from 28.2 percent in 1990 (see Fig. 4).

Whites (exclusive of Hispanics) will add 7.2 million through the year 2005 and another 3.3 million by 2015. Most of the next decade's addition will be via immigrants rather than from any natural growth.

Blacks, excluding census-identified black Hispanics, are projected to increase to 36.6 million in 2005 and 41.9 million by 2015, representing 12.9 and 13.8 percent, respectively. Their increase would be more substantial if it were not for their high death rate. A recent study by the District of Columbia Public Health Department indicated that the national black mortality rate was 4.5 times the white rate. Even of the preventable diseases, such as tuberculosis, hypertensive heart disease, and pneumonia, blacks were more likely to die earlier than whites. The mortality rate for black infants was registered at 17.6 per thousand in 1990, more than twice the rate of 8.5 for white infants. Homicide was the leading cause of death among black 15-to 44-year olds. In the 25-to 44-age group, blacks were 2.5 times more likely to die than whites. Rising AIDS and homicide rates have cut the average life expectancy of black males to 64.9 years in 1988 from 65.2 in 1987, compared to 72.3 years for white males.

Hispanics will double their numbers in 25 years and become a larger minority than Blacks (see Fig. 5). They totalled 22.4 million according to the 1990 Census and will be 44.5 million in 2015. Their rapid increase is attributed both to high rates of immigration and fertility. They represent the largest group of illegal immigrants of the last two decades, fleeing poverty and political instability in their countries. With the relatively easy access across an almost uncontrollable frontier, their flow into the United States has been largely unimpeded. The amnesty several years ago legalized approximately two million; there are thousands more unaccounted for. Without legal resident status, they are ineligible for many federal welfare programs. Many of them are teens who work for substandard wages and are forced to live with friends and relatives in crowded quarters. Because they work in order to be able to send money back to their countries to help their families, these teens have not been able to readily further their education.

Asians make up the next largest minority group. They have increased tremendously in the last decade: over 95 percent. Asians had a higher fertility rate and lower death rate than whites. The death rate among Asian adults in 1988 was about half that of white adults. Immigration accounted for most of the growth registered in the last decade because the United States admitted more than a million refugees from Southeast Asia. The number of Asians will continue to increase, but at a much lower rate because immigration has dropped. If the economies of many Asian countries prosper as expected, fewer Asians will attempt to migrate to the United States. Nevertheless, a number from less economically fortunate areas are expected to come before the year 2000, especially those having relatives in the United States. Approximately 500,000 Hong Kong residents, and some from Taiwan, are expected to emigrate to the United States, especially when Hong Kong reverts to China in 1997. By 2015, Asians will number about 13 million, representing 4.4 percent of the total population, up from the 2.9 percent in 1990.

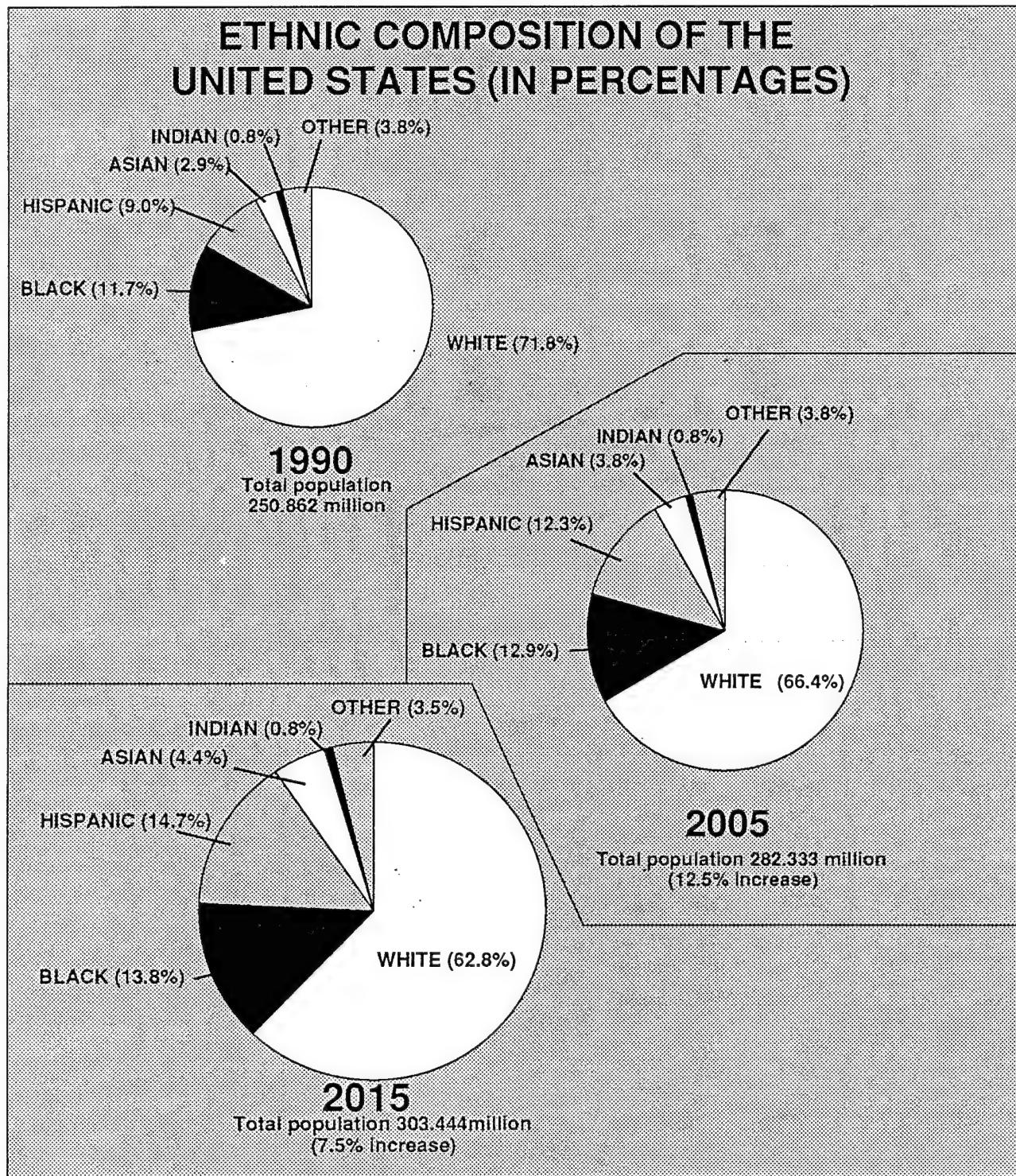


Fig. 4

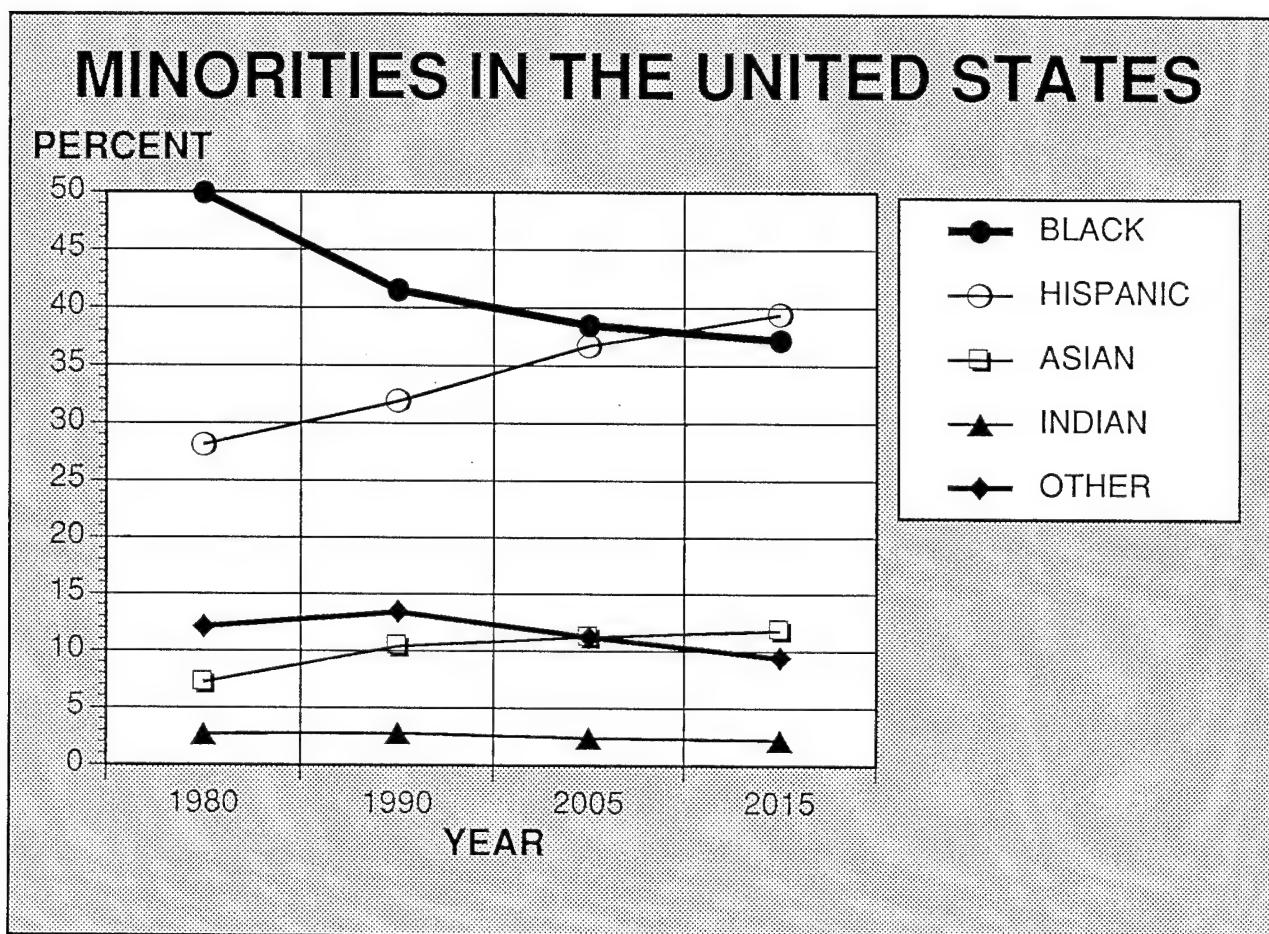


FIG. 5

American Indians, including Aleuts, increased about 38 percent during the last two censuses to almost 2 million. This growth is attributed to the increased tendency of people with some Indian ancestry to designate themselves as Indian for the 1990 Census, but as white or some other ethnic group in earlier tallies. Their natural growth rate has been low and is expected to remain at the same level for the next 25 years. With no further identity changes, they will number about 2.5 million in 2015.

The number in "Others" grew over 45 percent between 1980 and 1990, from 6.8 to 9.5 million, in part because of the inability to identify the individual's true category. These persons include those who, for personal reasons, did not find it possible to indicate the appropriate Bureau of the Census race/ethnic designation (White, Black, Hispanic, Asian, American Indian, or Aleut). Millions fell into this category.

The Bureau of the Census is in the process of adjusting these data for "Others" and it will attempt to elicit more accurate information on the origin of respondents. These individuals will be assigned an ethnic/race designation deemed appropriate based on other information gleaned from the census forms. Until the number of "Others" is revised and its existing base of data is reflected more precisely, the population of "Others" is projected to be about 10.6 million in 2015.

Individuals of mixed race are included in the "Others" category. Interracial marriages have increased considerably, from 310,000 in 1970 to 956,000 in 1988. These marriages are expected to continue to rise as prejudice against interracial marriage diminishes. The children of these unions will have the choice of self-identification when they reach the age of 18. Until that time, they will be classified under the race/ethnic category of their fathers or single mothers. The number of ethnic groups identified will be affected significantly by changes made by these young mixed-race adults in future censuses. The Bureau of the Census is currently developing additional ethnic designations for the census of 2000.

High and low projections of ethnic groups are shown in Table 7.

**Table 7. Composition of Population by Ethnic Group  
and Type of Projection, 2005 and 2015  
(in thousands)**

Ethnic Group	Low Projection		High Projection	
	2005	2015	2005	2015
White	185,680	183,573	191,172	194,847
Black	31,749	32,314	38,015	45,526
Hispanic	24,938	28,530	36,327	47,948
Asian	8,062	8,546	11,726	16,416
Indian	2,060	2,100	2,354	2,589
Other	9,874	10,009	12,116	13,168
<b>TOTAL</b>	<b>262,363</b>	<b>265,072</b>	<b>291,710</b>	<b>320,494</b>

Date of population is July 1.

The number of Hispanic males 18-to 25-years-old will reach 2.5 million in 2005 up from 1.7 million in 1990, an increase of 41.4 percent, the fastest growth of all ethnic groups. For the same period, blacks and Others, which include Asians and American Indians, will follow with a growth rate of 12.3 percent and 20.8 percent, respectively. At the same time, the number of white males will decline by one million (see Table 8).

**Table 8. Selected Age Cohorts by Ethnic Group and Sex, 1990, 2005, and 2015**  
 (in thousands)

Ethnic Group	Age 18-25			Age 26-45	
	Male	Female		Male	Female
<b>1990</b>					
White	10,215	10,052		29,168	28,854
Black	2,026	2,091		4,233	4,813
Hispanic	1,740	1,605		3,685	3,445
Other	1,283	1,207		3,111	3,260
<b>TOTAL</b>	<b>15,264</b>	<b>14,955</b>		<b>40,197</b>	<b>40,372</b>
<b>2005</b>					
White	9,251	9,083		25,000	24,811
Black	2,276	2,305		4,816	5,352
Hispanic	2,461	2,287		5,594	4,982
Other	1,550	1,507		3,430	3,585
<b>TOTAL</b>	<b>15,538</b>	<b>15,182</b>		<b>38,840</b>	<b>38,730</b>
<b>2015</b>					
White	9,211	9,037		22,295	22,219
Black	2,542	2,569		5,084	5,573
Hispanic	3,085	2,887		6,789	6,117
Other	1,565	1,512		3,704	3,841
<b>TOTAL</b>	<b>16,403</b>	<b>16,005</b>		<b>37,872</b>	<b>37,750</b>

Date of population is July 1.

## Regional Population Trends and Projections

### Regional

The last two censuses identified the West as having the fastest growth rate in the country at 23.4 percent, followed by the Southeast, 14.8 percent, and Southwest, 11.2 percent. The West, next to the Southwest, was one of the two least populated regions in 1990, but it will be one of the two most populous in 2015. Its inhabitants represented only 19.2 percent of the total, but will increase to 21.9 percent. By contrast, the Midwest, most populous in 1990 with 22.9 percent of the total population, will decline to 19.1 percent (see Fig. 6).

In addition to the large immigration of Asians and Hispanics who seem to prefer to settle in these warmer regions, other factors contributing to their growth are the migration of people from economically troubled industries in the Northeastern and Midwestern states. In addition, two-thirds of all retirees moved to these warmer areas, boosting local economies, since retirees often contribute more than they demand. Older migrants use fewer public services, and the taxes generated by the contribution of their retirement incomes substantially offset any public costs. Their spending has a great impact on the economy of a community. Many states are vying for out-of-state retirees. This growing competition may change the size, direction, and composition of the migration pattern of the elderly in the next 25 years.

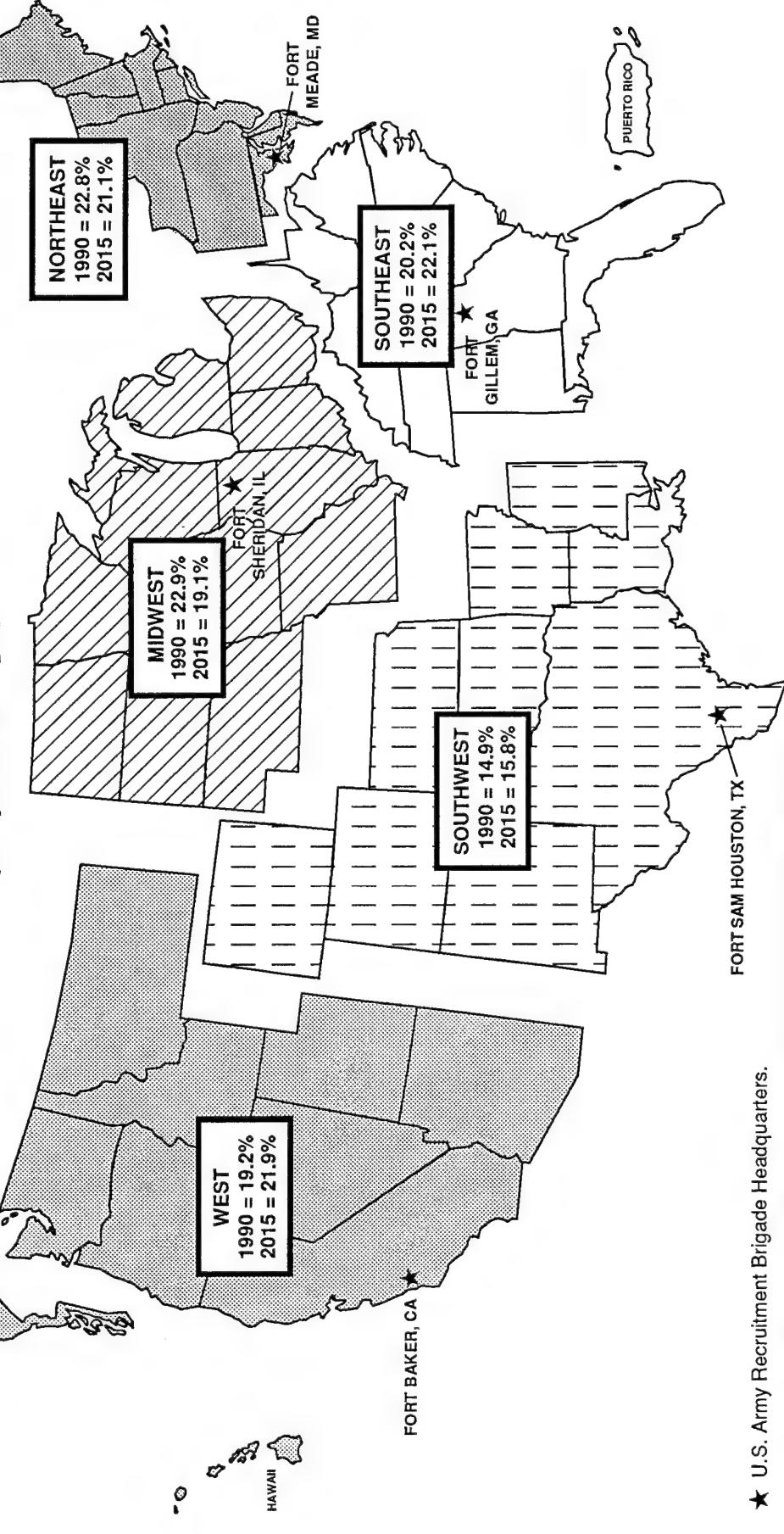
**Table 9. Regional Population Distribution  
by Army Recruitment Division, 1990, 2005, and 2015**

Division	1990		2005		2015	
	Number*	%	Number*	%	Number*	%
Northeast	57,222	22.8	61,302	21.7	63,922	21.1
Southeast	50,663	20.2	61,111	21.6	67,059	22.1
Midwest	57,515	22.9	57,955	20.5	58,010	19.1
Southwest	37,362	14.9	43,300	15.4	47,860	15.8
West	48,100	19.2	58,665	20.8	66,593	21.9
<b>TOTAL</b>	<b>250,862</b>	<b>100.0</b>	<b>282,333</b>	<b>100.0</b>	<b>303,444</b>	<b>100.0</b>

\*In thousands

Date of population is July 1.

**POPULATION SIZE  
BY U. S. ARMY RECRUITMENT DIVISION\***  
**1990 - 2015**  
**(in percentage)**



★ U.S. Army Recruitment Brigade Headquarters.

\* U.S. Army Recruitment Divisions are shown without states divided between divisions.

**Fig. 6**

The population growth in the Southern and Western regions is expected to continue through the year 2015 but at a lower rate. It is estimated that in 2015 the West will have an additional 18.5 million people reaching, 66.6 million; the Southeast will add 16.4 million to its 50.7 million; and the Southwest will increase to 47.9 million, or 10.5 million more (see Table 9).

## States

Between the two census years 1980-90, the state that topped all gains was Nevada, with a 50.1 percent increase, followed by Alaska with 36.9 percent, Arizona with 34.8 percent, and Florida with 32.7 percent. California, as expected, remained the most populous state in the nation, followed by New York, Texas, and Florida. Large influxes of Asian and Hispanic immigrants and of people from the East Coast and the recession-stricken industrial Midwest accounted for most of the population growth in California, Texas, and Florida. California's Hispanic population grew nearly 70 percent in the last decade, while Asians increased 127 percent. The 7.7 million Hispanics, representing 25.8 percent of California's population in 1990 or 34.4 percent of the nation's Hispanics, outnumbered the total population of all but eight states. Their growth is attributed to immigrants from countries below the southern border of the United States and to the high reproductive rate of the population already in the state. California also had the largest group of Asians in the country, with a total of over 2.8 million as of 1990, representing 39.1 percent of all Asians. New York had 2.2 million Hispanics and 0.7 million Asians, or 12.3 percent and 3.9 percent respectively of New York's total population. Texas was second to California in Hispanic population, with over 4.3 million, which also reflects the impact of immigration from countries below the southern border. Asians in Texas numbered 0.3 million. Florida tallied 1.6 million Hispanics and 0.2 million Asians among its population. Five areas that lost some population in the 1990 Census were Montana, North Dakota, Iowa, West Virginia, and the District of Columbia. The District of Columbia is contesting the 1990 Census count. The Bureau of the Census has admitted that it had missed up to 58,000 residents. Because of shifts occurring in the United States in manufacturing and industrial development these trends are likely to continue (see "Economy").

In 25 years, California will still have the country's largest population. New York will fall from second (its ranking after the 1990 Census) to fourth behind Texas and Florida by 2025. Eleven states in the middle portions of the country are expected to lose some population. By contrast, the District of Columbia will regain some (see Table 10).

**Table 10. Regional Population by Army Recruitment  
Division and State, 1990, 2005, and 2015**

Division and State	1990		2005		2015
	Number*	% change	Number*	% Change	Number*
<b>Northeast</b>					
Connecticut	3,305	9.4	3,617	4.6	3,785
Delaware	675	17.0	790	10.1	870
District of Columbia	610	5.9	646	6.3	687
Maine	1,245	9.3	1,361	5.4	1,435
Maryland	4,830	18.7	5,732	9.7	6,290
Massachusetts	6,050	7.9	6,526	5.0	6,850
New Hampshire	1,130	24.4	1,424	11.7	1,590
New Jersey	7,770	13.9	8,853	7.0	9,475
New York	18,082	4.5	18,892	3.1	19,485
Pennsylvania	11,945	-1.8	11,730	-0.9	11,620
Rhode Island	1,010	9.5	1,106	6.2	1,175
Vermont	570	9.6	625	5.6	660
<b>Total Northeast</b>	<b>57,222</b>	<b>7.1</b>	<b>61,302</b>	<b>4.3</b>	<b>63,922</b>
<b>Southeast</b>					
Alabama	4,075	11.1	4,530	6.5	4,824
Florida	13,145	33.6	17,567	12.7	19,800
Georgia	6,555	29.7	8,500	14.5	9,730
Kentucky	3,700	0.0	3,700	-0.4	3,685
North Carolina	6,690	19.6	8,000	10.6	8,850
South Carolina	3,525	17.7	4,150	8.9	4,520
Tennessee	4,915	11.2	5,464	6.6	5,825
Virginia	6,255	19.1	7,450	9.2	8,135
West Virginia	1,803	-2.9	1,750	-3.4	1,690
<b>Total Southeast</b>	<b>50,663</b>	<b>20.6</b>	<b>61,111</b>	<b>9.7</b>	<b>67,059</b>
<b>Midwest</b>					
Illinois	11,490	0.0	11,490	-0.1	11,480
Indiana	5,575	-0.3	5,558	-0.2	5,545
Iowa	2,788	-8.5	2,550	-4.3	2,440

Division and State	1990		2005		2015
	Number*	% change	Number*	% Change	Number*
Michigan	9,345	-0.2	9,325	-0.3	9,300
Minnesota	4,405	7.8	4,747	2.2	4,850
Missouri	5,155	8.0	5,567	2.6	5,710
Nebraska	1,588	-1.1	1,570	-0.6	1,560
North Dakota	641	-3.3	620	-1.6	610
Ohio	10,908	-0.1	10,900	-0.1	10,885
South Dakota	700	4.0	728	3.7	755
Wisconsin	4,920	-0.4	4,900	-0.5	4,875
<b>Total Midwest</b>	<b>57,515</b>	<b>0.8</b>	<b>57,955</b>	<b>0.1</b>	<b>58,010</b>
<b>Southwest</b>					
Arkansas	2,370	9.0	2,583	6.3	2,745
Colorado	3,330	18.0	3,928	9.5	4,300
Kansas	2,490	5.0	2,614	3.9	2,715
Louisiana	4,240	3.2	4,374	3.1	4,510
Mississippi	2,595	12.3	2,914	8.1	3,150
New Mexico	1,535	30.9	2,010	17.7	2,365
Oklahoma	3,167	7.6	3,407	6.4	3,625
Texas	17,180	22.4	21,025	14.2	24,000
Wyoming	455	-2.2	445	1.1	450
<b>Total Southwest</b>	<b>37,362</b>	<b>15.9</b>	<b>43,300</b>	<b>10.5</b>	<b>47,860</b>
<b>West</b>					
Alaska	565	28.0	723	14.8	830
Arizona	3,725	33.6	4,975	16.1	5,775
California	30,090	23.7	37,225	14.7	42,700
Hawaii	1,130	28.4	1,451	20.6	1,750
Idaho	1,017	7.4	1,092	5.8	1,155
Montana	805	-0.6	800	1.6	813
Nevada	1,230	31.7	1,620	14.8	1,860
Oregon	2,870	8.8	3,122	6.7	3,330
Utah	1,743	19.6	2,085	11.8	2,330
Washington	4,925	13.1	5,572	8.6	6,050

Division and State	1990		2005		2015
	Number*	% change	Number*	% Change	Number*
Total West	48,100	22.0	58,665	13.5	66,593
UNITED STATES	250,862	12.5	282,333	7.5	303,444

\*in thousands; date of population is July 1.

## Cities

The 1990 Census shows that for the first time, more than half of the country's population lives in standard metropolitan areas (S.M.A.). Most of the national population growth in the last decade occurred in these areas (see Table 11). Smaller cities also gained population and new small cities mushroomed throughout the country. While large and small cities proliferated, rural towns became relatively deserted. Young rural people left their towns for better opportunities in the cities. Losses in rural population were highest in the Midwest. This trend is likely to continue in the forecast period. Further depopulation of the central sections of the United States are expected with the continuing decline in agricultural employment (see "Economy").

The fastest growing metropolises were in Florida and in the Southwest: Orlando recorded a 53.3 percent increase over 1980; Naples grew by 77 percent; Fort Pierce, 66 percent; and Fort Myers, 63 percent. The growth in these S.M.As is attributed primarily to retirees. Fast growing S.M.As in other states include Las Vegas, Nevada with a 60 percent increase; Austin, Texas with 46 percent; and Las Cruces, New Mexico with 41 percent. The New York metropolitan area was among the slower growing areas, with only a 3.1 percent gain over the decade; nevertheless it remained the country's largest with 18.1 million, up over half a million from 1980. Los Angeles followed with over 14.5 million, or an increase of 26.4 percent over 1980. If New York and Los Angeles continue to grow at their present rates, the population of metropolitan Los Angeles will outnumber that of New York by the year 2005. Five S.M.As -- Cleveland, Detroit, Pittsburgh, New Orleans, and Buffalo -- have suffered population losses during the same period. As metropolitan areas grow in population and annex additional territories, the affected central cities lose some of their population. City residents with sufficient income flee to the more attractive suburban areas where crime and drug use are low and housing is more affordable. The result is a diminishing population and tax base for the losing central cities. In the last 15 years several cities have also lost jobs to the burgeoning nearby suburbs. According to a recent report by the National League of Cities, incomes of people in the largest central cities are lower than those of the suburbanites by 41 percent. Central cities had 43 percent of the nation's poor in 1989 as compared with the 37 percent in 1979.

The overall data indicate a dramatic shift of population from Northeast and Midwest to the South and West. The data also show that people tend to move to areas with concentrations of at least

one million people where jobs are more readily available. The Los Angeles S.M.A. and the Boston S.M.A. top the list of 25 areas expected to generate new jobs through the year 2000. Table 12 shows how the ranking of these 25 cities changed in four years (1982-86). As the structure of the economy changes, these trends will continue through the forecast period.

**Table 11. Metropolitan Areas Having Population  
of One Million or More in 1990, Compared with 1980**

Metropolitan Area	1980*	1990*	% Change
New York	17,539,532	18,087,251	3.1
Los Angeles	11,497,549	14,531,529	26.4
Chicago	7,937,290	8,065,633	1.6
San Francisco	5,367,900	6,253,311	16.5
Philadelphia	5,680,509	5,899,345	3.9
Detroit	4,752,764	4,665,236	-1.8
Boston	3,971,792	4,171,643	5.0
Washington	3,250,921	3,923,574	20.7
Dallas	2,930,568	3,885,415	32.6
Houston	3,099,942	3,711,043	19.7
Miami	2,643,766	3,192,582	20.8
Atlanta	2,138,136	2,833,511	32.5
Cleveland	2,834,062	2,759,823	-2.6
Seattle	2,093,285	2,559,164	22.3
San Diego	1,861,846	2,498,016	34.2
Minneapolis	2,137,133	2,464,124	15.3
St. Louis	2,376,968	2,444,099	2.8
Baltimore	2,199,497	2,382,172	8.3
Pittsburgh	2,423,311	2,242,798	-7.4
Phoenix	1,509,175	2,122,101	40.6
Tampa	1,613,600	2,067,959	28.2
Denver	1,618,461	1,848,319	14.2
Cincinnati	1,660,257	1,744,124	5.1
Milwaukee	1,570,152	1,607,183	2.4
Kansas City	1,433,464	1,566,280	9.3
Sacramento	1,099,814	1,481,102	34.7
Portland, Oregon	1,297,977	1,477,895	13.9
Norfolk	1,160,311	1,396,107	20.3
Columbus	1,243,827	1,377,419	10.7

Metropolitan Area	1980*	1990*	% Change
San Antonio	1,072,125	1,302,099	21.5
Indianapolis	1,166,575	1,249,822	7.1
New Orleans	1,256,668	1,238,816	-1.4
Buffalo, New York	1,242,826	1,189,288	-4.3
Charlotte, N.C.	971,447	1,162,093	19.6
Providence, R.I.	1,083,139	1,141,510	5.4
Hartford, Conn.	1,013,508	1,085,837	7.1
Orlando, Florida	699,904	1,072,748	53.3
Salt Lake City	910,222	1,072,227	17.8
Rochester, New York	971,320	1,002,410	3.2

\*Census year; date of census is April 1.

**Table 12. Ranking of Cities Having Greatest Employment Opportunities, 1982 and 1986**

CITY	1982	1986
Houston	1	7
Anaheim-Santa Ana	2	3
Los Angeles-Long Beach	3	1
San Jose	4	4
Dallas	5	9
Denver	6	16
Phoenix	7	5
Washington, D.C.	8	6
San Diego	9	11
Boston-Lawrence-Salem	10	2
Atlanta	11	10
Tampa-St. Petersburg	12	12
Fort Lauderdale-Hollywood	13	21
Minneapolis-St. Paul	14	17
San Francisco	15	15
Austin	16	---
Miami-Hialeah	17	22
Orlando	18	20
Oakland, California	19	23
Nassau-Suffolk, N.Y.	20	19
Seattle	21	24
West Palm Beach-Boca Raton	22	25
San Antonio	23	---
Baltimore	24	---
Tucson	25	---
Chicago	---	8
Philadelphia	---	13
New York	---	14
Detroit	---	18

"---" denotes ranked below 25

## HISPANIC POPULATION

Within the next two decades, Hispanic-Americans will be the largest minority group in the United States. They made up 9.0 percent of the U.S. population in 1990, up from 6.4 percent in 1980, a growth attributable to both rapid immigration and high fertility. At this rate, they should reach over 44.4 million in 2015 or 14.6 percent of the total population. In the event of worsening conditions, i.e., political turmoil or deteriorating economic conditions in the countries below the southern border, there will be larger influxes of immigrants. The number of Hispanics could reach 48 million. On the other hand, if conditions improve (i.e., there is political stability and prosperity) large numbers of Hispanics in the United States would possibly return to their former countries. Thus the number of remaining Hispanics could be as low as 28.5 million in 2015 (see Table 13).

**Table 13. Hispanic Population by Type  
of Projection, 2005 and 2015  
(in thousands)**

Type of Projection	2005	2015
Low	24,938	28,530
Medium	34,792	44,450
High	36,327	47,948

Date of population is July 1.

The Hispanic population is younger, poorer, less educated and from larger families than other ethnic groups. Their median age in 1990 was 25.6 and will be 27.5 in 2005 and 29.0 in 2015. As shown in Table 14, Hispanics aged 18 to 45 will represent 44.0 percent of the total Hispanic population in 2005 and 42.4 percent in 2015 (medium projection.) In 1989, Hispanics aged 18 to 25 dropped out of high schools at a rate of 62.8 percent. Of this age group, 16.1 percent enrolled in college, 56 percent of them in two-year colleges. Enrollment in graduate school fell by 15.2 percent between 1986 and 1988. Table 15 reflects the Hispanic population distribution and by age cohorts and by sex for the years 2005 and 2015.

**Table 14. Distribution of Hispanic Population  
by Selected Age Cohorts and Type of Projection, 2005 and 2015**

Type of Projection and Age Cohort	2005		2015	
	Number*	%	Number*	%
<b>Low</b>				
Age 18-25	3,347	13.4	3,495	12.3
Age 26-45	7,308	29.3	8,202	28.7
<b>Medium</b>				
Age 18-25	4,748	13.6	5,972	13.4
Age 26-45	10,576	30.4	12,906	29.0
<b>High</b>				
Age 18-25	4,835	13.3	6,409	13.4
Age 26-45	10,595	29.2	13,086	27.3

\*In thousands

Date of population is July 1.

The largest concentration of Hispanics will be found in the West, with an estimated 42.1 percent of total Hispanic population in 2005 and 43.2 in 2015. The Southwest will have over 25 percent of the Hispanics, and the Northeast about 16 percent (see Table 16). Metropolitan areas containing large Hispanic populations are shown in Table 17. Hispanic population distribution by selected age cohorts and by Army Recruitment Division is shown in Table 18 and Figure 7.

**Table 15. Distribution of Hispanic Population  
by Age Cohort and Sex, 2005 and 2015  
(in thousands)**

Age	2005		2015		
	Cohort	Male	Female	Male	Female
0-4	1,745	1,669	2,110	2,018	
5-17	4,272	4,084	5,053	4,832	
18-25	2,461	2,287	3,085	2,887	
26-45	5,594	4,982	6,789	6,117	
46-65	2,839	2,896	4,392	4,186	
66-79	643	842	987	1,246	
80+	163	315	255	493	
<b>TOTAL</b>	<b>17,717</b>	<b>17,075</b>	<b>22,671</b>	<b>21,779</b>	

Date of population is July 1.

**Table 16. Hispanic Population by Army  
Recruitment Division, 2005 and 2015**

Division	2005		2015	
	Number*	%	Number*	%
Northeast	5,740	16.5	7,023	15.8
Southeast	3,270	9.4	4,178	9.4
Midwest	2,296	6.6	2,709	6.1
Southwest	8,838	25.4	11,335	25.5
West	14,648	42.1	19,205	43.2
<b>TOTAL</b>	<b>34,792</b>	<b>100.0</b>	<b>44,450</b>	<b>100.0</b>

\*In thousands

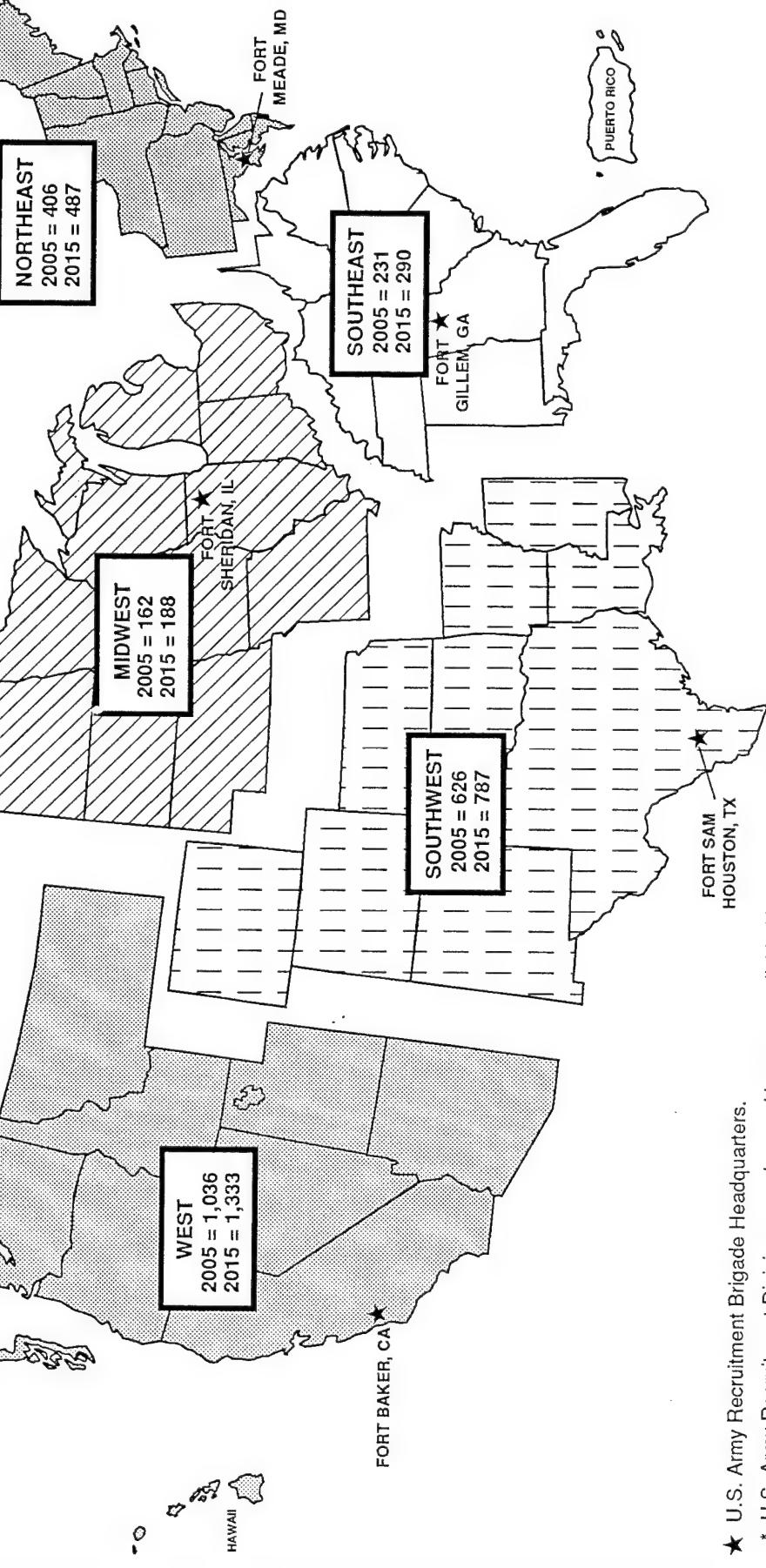
Date of population is July 1.

**Table 17. Metropolitan Areas Having Over  
40,000 Hispanic Population, 1988  
(in thousands)**

Metropolitan Area	Population	% Metro Area
Boston-Lawrence-Salem-Lowell-Brockton	103.6	2.8
Chicago-Gary-Lake County	811.1	9.9
Cleveland-Akron-Lorain	44.9	1.6
Dallas-Fort Worth	400.2	10.7
Denver-Boulder	200.4	10.5
Detroit-Ann Arbor	87.1	1.9
Hartford-New Britain-Middletown-Bristol	52.8	4.7
Honolulu	60.8	7.2
Houston-Galveston-Brazoria	667.5	18.5
Los Angeles-Anaheim-Riverside	4,072.7	29.3
Miami-Fort Lauderdale	858.5	28.0
Milwaukee-Racine	45.6	2.9
New Orleans	53.6	4.0
New York-Northern New Jersey-Long Island	2,499.2	13.8
Orlando	40.7	4.1
Philadelphia-Wilmington-Trenton	176.6	3.0
Phoenix	305.3	14.8
Sacramento	159.2	11.4
Salt Lake City-Ogden	55.8	5.2
San Antonio	667.0	51.4
San Diego	425.7	17.9
San Francisco-Oakland-San Jose	893.5	14.7
Seattle-Tacoma	54.5	2.3
Tampa-St. Petersburg-Clearwater	116.4	5.7
Washington, D.C.	122.1	3.3

**MALE HISPANICS OF RECRUITMENT AGE (18-25)  
BY U. S. ARMY RECRUITMENT DIVISION  
(POPULATION IN THOUSANDS)**

2005 - 2015



★ U.S. Army Recruitment Brigade Headquarters.

\* U.S. Army Recruitment Divisions are shown without states divided between divisions.

**Fig. 7**

**Table 18. Hispanic Population by Selected Age Cohort, Sex, and Army Recruitment Division, 2005 and 2015  
(in thousands)**

Division and Age Cohort	2005		2015	
	Male	Female	Male	Female
<b>Northeast</b>				
Age 18-25	406	377	487	456
Age 26-45	923	822	1,073	966
<b>Southeast</b>				
Age 18-25	231	215	290	272
Age 26-45	526	468	638	575
<b>Midwest</b>				
Age 18-25	162	151	188	176
Age 26-45	369	329	414	373
<b>Southwest</b>				
Age 18-25	626	581	787	736
Age 26-45	1,421	1,266	1,731	1,560
<b>West</b>				
Age 18-25	1,036	963	1,333	1,247
Age 26-45	2,355	2,097	2,933	2,643

Date of population is July 1.

Hispanics in the United States vary greatly in their education, economic status, and ability to cope in American society and culture. Because so many are first-generation immigrants, they tend to cling to their native culture. It is believed that only 26 percent of them are fluent in English and that 47 percent struggle to cope with the language. More than 2 million adults speak only Spanish. Nearly three in four continue to speak Spanish at home; few families in California and New Mexico have completely adopted English. Those born in the United States are fluent in English and thereby earn as much as

people of European descent. This trend follows historical patterns of immigration. It is expected that a greater degree of assimilation will occur with succeeding generations.

Cuban-Americans, estimated to number 1.0 million in 1990, or 4.6 percent of the total Hispanic population, are concentrated in Florida. Some of them have settled in the New York Metropolitan Area. In 1987 the Cubans were reported to have a median family income of nearly \$27,000, the highest of all Hispanics.

Mexican-Americans, estimated to number 13.496 million, made up 60.4 percent of the 1990 Hispanic population. In the 1980 census, 74 percent were native born. The median age of Mexican-Americans is 24 years, compared to 33 for all U.S. residents. They tend to marry young and have children at early ages. Mexican-American women have experienced less marital instability than other Hispanic women, except for Cubans. As a result, the proportion of Mexican-American children living in two-parent households is higher than other Hispanic groups. But like all ethnic groups in the U.S., the number of Mexican-American single-parent households is rising.

Mexican-Americans are concentrated in California and in other parts the Southwest, the majority in urban areas. The Los Angeles area has about 2 million Hispanics of Mexican origin; more than 70 percent of them are under age 35. There are many well developed Mexican communities in the Southwest that newcomers can blend in with easily, causing great difficulties for the too few federal authorities whose job it is to apprehend illegal or undocumented immigrants from south of the border. Because the newcomers do not have to relinquish their language or cultural ties, their rate of assimilation and acculturation to American ways is slow.

In 1988 the median Mexican-American family income was \$21,025, about two-thirds of the national median family income of \$32,191. More than 19 percent of Mexican-American families were headed by women and half of these live in poverty. According to the 1989 Bureau of Census data, about 25 percent of all Mexican-American families lived below the official poverty line. Except for Puerto Ricans, this poverty rate exceeds that of all Hispanic groups.

Puerto Ricans, the majority living in New York and New Jersey, totalled over 2.7 million in 1990, or 12.2 percent of the total Hispanic population. Their family income was \$14,600 in 1987. Forty-three percent of Puerto Rican families were headed by women in 1987; two-thirds of them lived below the poverty line. It is estimated that one-third of the people who identify themselves as Puerto Ricans live not in Puerto Rico but in the United States.

Other Hispanics, numbering 5.1 million in the 1990 Census, are from the Caribbean, Central and South America. It is believed that 300,000 Hispanic immigrants have come from the Dominican Republic and over 500,000 from El Salvador.

## SIGNIFICANCE OF THE DEMOGRAPHIC DATA

The demographic data presented above indicate that by the year 2015, the United States will have a sizable aging population, a smaller work force, more retirees for far fewer workers, a working group

whose working age will have to be extended to 70, a good many households headed by single parents, a declining number of white Americans, an increasing size of minority populations that will make up 37.8 percent of the total population, and a need for more social services.

### Implications for the Army

In 2015, the population of the United States will be aging and highly urbanized, and will comprise a sizeable ethnic minority.

Unless the draft is reinstated forcing thousands of 18-25-year-olds into the Army (see "Society"), the average Army soldier will be over the age of 30, married with children or a single parent. This will be the oldest in combat since the Civil War.

There will be a rise in single-parent households, the majority of which will be headed by women. If women continue to increase their proportion of the military population (active duty and reserve) then the presence of these single mothers in the military will require the Army to provide more social services to alleviate the burden of care for children while parents are away on duty.

Hispanics will be the largest minority group, with an expected total of 44.4 million; followed by blacks with 41.9 million; and Asians with 13.3 million. Hispanics will be concentrated in the West and Southwest; Asians, in the West and Northeast; and blacks, in the Southeast and Northeast.

Immigration has been one of the key factors to the nation's population growth and that trend will continue up to the year 2000. Most future immigrants will continue to be Asian and Hispanic. Asians who immigrate will do so mainly because of relatives in the United States; others will go to other prosperous Asian countries close to home, or to Australia, New Zealand, and Canada. Hispanics will continue to cross over the U.S. southern borders as long as abject poverty and political instability prevail in their countries. The Immigration Act of 1990 allows skilled Europeans to immigrate to the United States but their numbers have been small and will, in all likelihood, remain small. Those who are economically despondent will queue to cross over the borders of more affluent European countries, close to home.

The United States is expected to have 303.4 million people in 2015. Given a level of prosperity that is much higher than the Third World, continued high immigration into the United States is projected. This situation, coupled with high birth and low death rates, could bring the U.S. population to a larger number of 320.5 million; the number of Hispanics in this case would be about 48 million. On the other hand, if improving conditions -- political stability and prosperity -- prevail elsewhere, the U.S. immigration rate would become less significant. And with lower birth and higher death rates, the total population could be as low as 265.1 million; in this scenario, the number of Hispanics would grow only to 28.5 million.

Most of the national population growth will be attributed to ethnic minorities. Growing sizes of ethnic groups will put increasing pressure on many basic institutions, including the Army. A greater challenge will be posed to the old beliefs in inclusion, acculturation, and nondiscrimination. Of particular

interest to the army will be young people, ages 18 to 25. In this cohort, whites will represent 55.5 percent of total in 2015, a decline from 67.1 percent in 1990. By contrast, the minorities will grow from 32.9 percent in 1990 to 44.5 percent in 2015.

To attract ethnic minorities, especially the increasing number of Hispanics (the potential number of white recruits will decline), the Army will have to improve its recruitment tactics; providing potential Hispanic recruits with special training, including the English language, will be one of these tactical plans. The Army will also have to institute new programs to encourage and accelerate the process of acceptance, fostering greater cooperation among diverse ethnic groups.

The effects of the AIDS epidemic will persist through the forecast period. Because about 80,000 women of child-bearing age may prove to be HIV-positive, between 1,500 to 2,000 babies born each year could be HIV-positive. By 2015, many Army recruits will be found HIV-positive.

In sum, what will the U.S. Army see as its manpower pool in 2015? The number of potential Hispanic and Asian recruits will be much higher than at present, with percentages of white and black youth decreasing and remaining roughly the same, respectively. Many more will come from single-parent households and originate in the south and west of the United States.

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## **KEY JUDGMENTS**

### **THE ECONOMY**

- The decade of the 1990s will be one of rigorous examination and future development will depend on how the economy adapts to the globalized economy, the degree of relaxation in traditional U.S. laissez-faire policy toward commerce, and the ability of the economy to maintain productivity (with concomitant productivity of the labor pool).
- Changes affecting the U.S. economy will continue to occur at accelerated speed because, barring cataclysmic setback, economic conditions are closely linked with technological advancement.
- A major factor in economic success will be the feasibility of continuous expansion of the world economy to the benefit of all, and the internal political feasibility of exposing U.S. enterprises and labor to the increasingly transnational system.
- Continued automation of the goods producing sector is foreseen. A major factor will be the ability of producers to capture and hold fragmented and specialized markets. If there is hesitation then producers may be pushed toward basic products and away from high tech, ceding the latter to foreign competitors.
- Quantity of labor, certain to decrease, will be secondary to quality of labor, much less certain. Further automation will expand job markets for workers with high technical training and for those with basic unspecialized skills; the ratio to be determined by demands posed by new technology. Workers in the middle levels may well be less in demand.
- The military economy will be adjusting to a smaller force structure and will be increasingly dependent on high-tech weaponry. The adjustment period will include co-production with at least some now exclusively civilian producers and away from isolated production of highly specialized items. Budget considerations and perception of the threat will drive the military sector.

## **THE ECONOMY OF THE UNITED STATES IN 2015**

### **INTRODUCTION**

The condition of the U.S. economy in the next 25 years will be determined by a number of variables and trends, some intrinsic to the field of economics and some external. Factors such as investment policy and economic globalization are joined by the condition of the U.S. education system and demographic trends, for example, in forming a complex balance of possible outcomes. Likewise, the trends that will have impact during that period are now at various stages of development, and some in fact are not visible at all at the present time. One can predict securely, however, that one trend will continue: changes affecting the U.S. economy will continue to occur at accelerated speed because, barring a cataclysmic setback, economic conditions are closely linked with technological advancement.

Within that context, the goal of this paper is to identify and describe the prospective general impact of a small number of key issues, then to estimate the prospective impact on U.S. Army policy of the economic conditions created. The key issues are the relative proportion of the economy occupied by service and manufacturing sectors, and growth rates of each; changes in U.S. management practice and the availability and quality of the U.S. work force; enterprise structure and location patterns; the U.S. role in the global economic system; changes in economic planning and investment philosophy; and the relationship between the defense and civilian sectors of the economy. Future scenarios and the driver factors for them will be discussed. In such an assessment, the variety of scenarios matches the formidable breadth of creditable opinions, theories, and measurement techniques in current economic thought.

### **STRUCTURE OF THE ECONOMY**

The economy is conventionally divided into manufacturing and service sectors. The former includes plant production of tangible products, mining, and construction. The latter yields a wide variety of activities, such as sales, communications, equipment servicing, finance, transportation, information supply, food services, and education--some of which directly or indirectly facilitate the transfer of goods (such as sales) and some of which are essentially separate from the process of goods exchange (such as education).

The 1980s was a decade of drastic retrenchment and reshaping in U.S. manufacturing, although the overall economy grew by all measurements. Enterprises such as U.S. Steel and the Caterpillar heavy equipment company, bastions of U.S. conventional manufacturing, slashed their operations but greatly increased per capita productivity. The large construction firms that built giant malls and plants through

the 1980s began to shrink in proportion to the smaller scale of new projects.

Trend predictions in the manufacturing sector for the 1990s vary. According to one scenario, the United States will react to foreign manufacturing competition with a reinvigorated industrial output, signaling the end of the post-industrial era. [82] This renaissance would stem from a vast and assumedly judicious investment (one estimate says \$55 billion by 2000) in plant automation. Automating factories could preserve manufacturing's 20 percent (1987) contribution to the GNP and weaken the advantage of low-wage foreign competitors by making U.S. industry less labor-dependent. Another key ingredient of this scenario is industry's willingness to retool existing plants to accommodate changing demand in a world market increasingly geared to such accommodation.

Other forecasters see unaddressed flaws such as short-sighted planning and investment, neglect of personnel retraining, and inappropriate application of technology that could cause the U.S. manufacturing system to decline in the next decade, especially in comparison with Asian and European competitors. In this scenario, lack of flexibility will continue to block broad retooling in the next decade, just as markets for steel, machine tools, and electronics, among other products, were lost to overseas producers in the 1980s. [72]

A major criticism of U.S. industrial policy bears on future scenarios in the manufacturing sector: U.S. industrial R&D policy has supported new-product breakthrough development at the expense of maintaining the production processes that come later. The low-profit stage of pursuing and perfecting existing products, necessary to develop a long-term market, is thus sacrificed for the short-term profits associated with breakthroughs. Such a focus often leaves ready-made product markets to foreign competitors. An example was the video-recorder, developed in the United States but abandoned because early machines had limited applicability and the eventual commercial success of the product required years more of design adjustment.

The M.I.T. Commission on Industrial Productivity, formed in 1988, identified changes necessary to alleviate such competitive disadvantages. Streamlined management teams and worker input would promote flexibility and responsiveness to markets; simultaneous improvement of product quality and marketing would maintain markets beyond the short term; and more direct connection with market signals would improve industry responsiveness to fast-changing demand. [16] Amid any new emphasis on maintaining commercial markets, ideally the United States would retain its breakthrough design capacity, an activity in which it still leads the world in many fields.

Because many other analyses have identified similar needs, the degree to which they are filled is an important determinant of future U.S. market shares in the manufacturing industries where ground was lost in the 1980s. Already in 1990, basic industries such as construction materials and textiles had regained substantial shares of international markets by improving production efficiency, tightening quality control, and paring overhead—but optimism was curbed by the yet undetermined role of a lower exchange value of the dollar in the demand for U.S. goods abroad. Although the reversal occurred mainly in non-critical industries, in 1990 the United States recorded its first trade surplus in semiconductors in several years.

For the forecast period, several consumption factors will likely determine the emphasis of U.S. manufacturing: disposable income, longer service life in durable goods, and long-term societal attitudes toward consumption of such goods. (The supply-side theorists, on the other hand, stress that consumption is fueled by availability of goods, which if true would at least partly negate the foregoing influences.) Disposable income could be reduced for a large part of the U.S. population if health care costs continue to consume a greater portion of income--a scenario predicted by many unless a new health care system is devised. Production cost reduction has already shrunk wages in many goods-production industries, putting a potential long-term squeeze on blue-collar purchasing power.

In one scenario, the high-consumption 1980s will be followed by a decade of conservatism (encouraged by slow economic growth) and saving. The baby-boom generation, already well-supplied with durable goods, would support that trend by emphasizing savings over consumption spending. That might mean redistribution of resources away from non-durable manufacturing and some types of services into long-term investment.

On the other hand, given continued high consumer demand, the emphasis of consumer production should continue changing from mass-produced to individualized goods (e.g. minivans and off-road vehicles rather than standard family cars), fragmenting the market and requiring more compartmentalization of production operations. [9] Flat or decreased demand for durable goods (both often-predicted scenarios) would likely narrow the U.S. field to the most flexible and innovative producers after 2000, with foreign suppliers increasing their market shares.

In general, a scenario of U.S. industrial technology continuing to move abroad in the next decade would mean the United States making fewer high-value products and, as a result, less domestic circulation of economic wealth. The capital equipment industry, for example, should thrive past 2000 because of the large amount of outdated machines that U.S. industry will have to replace in the next decade. But segments of that industry such as machine tool manufacture are already dominated by Japan, and in 1985 U.S. machine firms were already buying 25 percent of their steel abroad. [72]

Standards such as growth in per capita manufacturing productivity and growth in percentage of GNP put into capital investment support the prediction that the sector can "turn the corner" by shedding inefficient operations, adopting new product lines in a timely fashion, and fine-tuning and refitting existing systems. In the context of the domestic economy, such strategy could preserve the manufacturing share of the GNP well beyond 2000. But this scenario may be based on an artificial environment: given the virtually universal prediction that no national economy will preserve even present levels of policy-making autonomy in the next 25 years, evaluation of the manufacturing sector without reference to trends and policies in Japan, Western Europe, or emerging Asian industrial states ignores a complex of key determinants. It also ignores the speed with which those competitors seize new markets if they perceive slack in them. An example with likely impact beyond 2000 is biotechnology--a field pioneered by the United States but, following a U.S. funding reduction in the late 1980s, now receiving substantial long-term Japanese commitment. [63] In the year 2000, the frequency and magnitude of shifts that have occurred in such key pioneer industries in the preceding decade will show the wisdom of the "fine-

tuning," gradual approach to reform of U.S. manufacturing.

Forecasts see as much as 90 percent of the U.S. work force in the service sector in 2000, up from 40 percent in 1964. [72] Figure 1 shows the trend in relative employment between services and manufacturing. Even given a scenario of resurgence in the manufacturing sector in the next 25 years, process automation may well reduce job slots in that sector at a faster rate than overall operations can expand, meaning a net job shift away from manufacturing. Slumps and advances in the services have been consistently more moderate than those in manufacturing--if that well-established trend continues, future service dominance of the economy would tend to moderate overall economic swings, perhaps making the U.S. economy more recession-proof.

The Bureau of Labor Statistics foresees particular growth in financial, health, and recreation services in the 1990s. [75] According to the Department of Labor, fourteen of the thirty fastest growing occupations during that decade will be health-related. For an economy moving strongly toward services, productivity growth is much more problematic than for an economy more recently industrialized, where services provide a smaller portion of employment and the recent introduction of modern production equipment yields rapid statistical jumps in productivity. [4] After the year 2000, U.S. service productivity growth will be an important determinant of economic health, both domestic and international. Because that growth has been virtually flat in recent decades, one post-2000 scenario is a U.S. economy dominated by service enterprises that contribute minimal growth, cancel whatever gains might be made in the manufacturing sector, and ultimately halt growth in the national standard of living. Such a scenario presumes that intrinsic elements of inefficiency will remain in major service sectors; it is based partly on the fact that average labor cost in services is 67 percent of the average in manufacturing, meaning that services are less likely to improve productivity by replacing people with machines. [4] Low productivity is found, for example, in conventional health care, where the process of product delivery may bear little relation to the purely economic part of the service transaction. Care of the elderly, an undoubtedly growing part of health services in the next 25 years, has many aspects of such inefficiency.

A second, more positive scenario sees streamlining and technology improving productivity (efficiency) in services without lowering product quality. For health care, automated self-service for routine medical testing is a possible device to streamline the conventional office visit. Computerized classrooms, direct sales, and computerized supermarket checkouts are existing examples of the trend that can be expected to multiply in the next 25 years. [4]

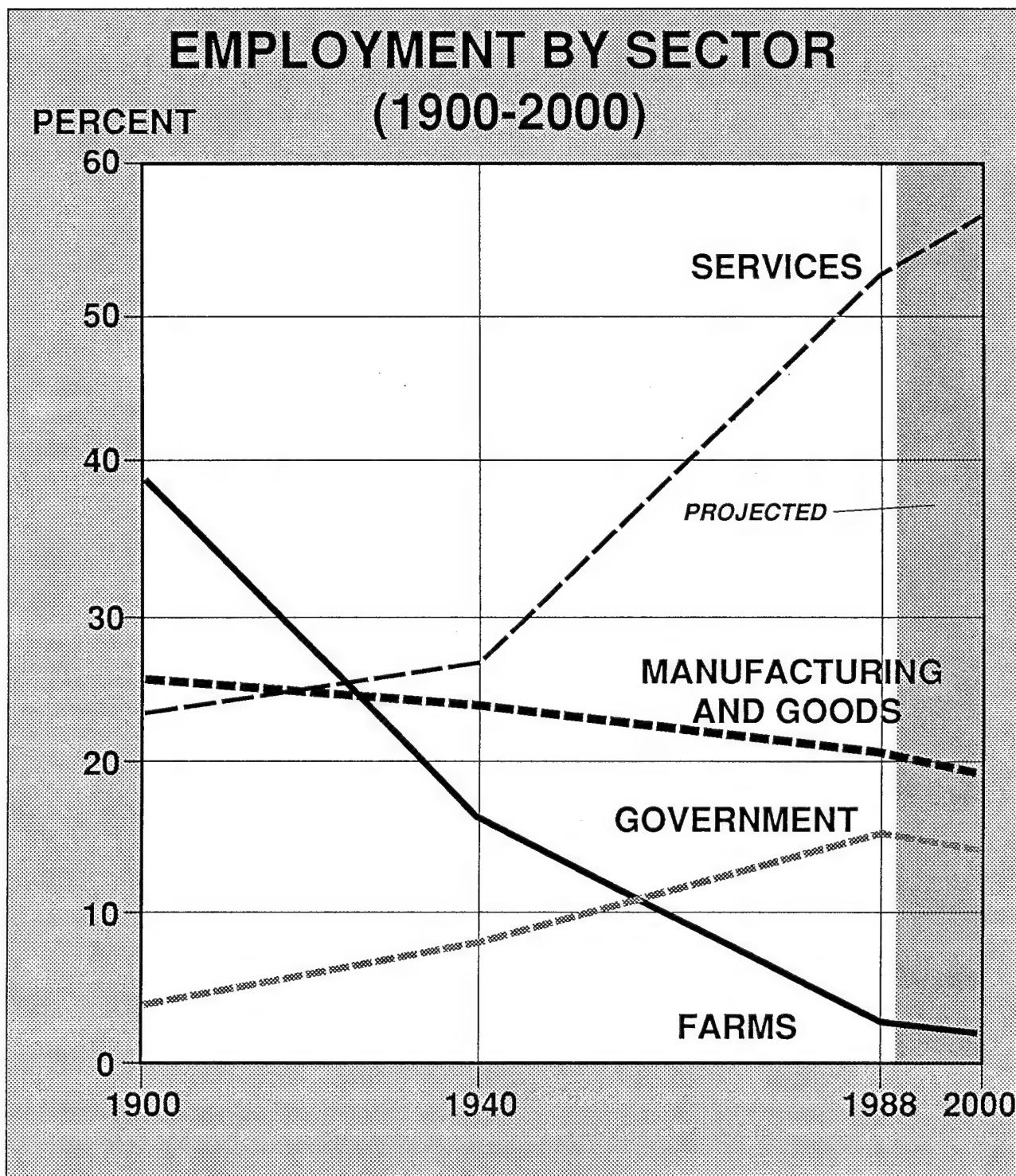


Fig. 1

A third scenario finds services occupying a stable portion of the economy after the year 2000, meaning that the influence of growth rates in that sector would also stabilize (albeit at a high level). Service productivity may also increase when faced with international competition, the same stimulant that some scenarios see reviving U.S. manufacturing. Financial and communications services, for example, increasingly will be forced to improve to meet world competition. There is seemingly room for improvement: service productivity in Germany is now much higher than that in the United States. [82] Exposure to domestic competition may have the same result in some services; transportation and education are services traditionally shielded from market competition, but potentially streamlined by deregulation (transportation) or privatization (education).

An argument has been made that many of the largest service areas have self-limiting characteristics that will cause a labor shift back into manufacturing. Only a certain number of restaurant meals can be eaten, for example, and cost may limit expansion of the health industry. A tight post-2000 labor market could shrink the service labor pool, forcing greater capital investment and from that higher productivity. [82]

Another aspect of the prospective relationship of manufacturing and services is the likelihood of increased integration between the two sectors. In the future, traditional manufacturing operations will become more dependent on rapid access to information about design and marketing, effective communications networks, and training for personnel operating sophisticated equipment. The Bureau of Labor Statistics expects communications equipment to be the fastest growing type of durable equipment purchase by producers in the 1990s [75]; the services rendered by the operators of communications networks will bond manufacturing to that part of the service economy for the foreseeable future.

How will new balances between and within the manufacturing and service sectors influence Army policy between the years 2000 and 2015? The scenario of a manufacturing sector continuing to lose markets to overseas competitors and contributing a shrinking share to the U.S. GNP would restrict defense purchasing options and likely shrink the contribution of U.S.-based R&D and manufacturing to defense projects. This scenario would include loss of defense-vital production facilities in electronics, machine tools, and semiconductors (as well as other technologies developed between now and 2015) to Asian or European competitors, meaning new dependence on suppliers beyond direct U.S. control. On the other hand, shrinkage of the manufacturing contribution to GNP would not by itself imply damage to the industrial base of the military. Especially given a scenario of improved productivity and continued expansion in the service sector, a drop from the current 20 percent share of manufacturing could be perfectly acceptable if it also meant that manufacturing had improved qualitatively. This would require more accurate and rapid assessment of market changes, flexible retooling to meet them, and greater commitment to programs of R&D and continuous process improvement. A manufacturing sector that has accomplished those objectives by 2000 would have retained substantial parts of the defense-vital industries or overseen their distribution abroad from a position of strength rather than weakness. It would be technologically ready for new production assignments, either civilian or military. The scenario of natural re-expansion of U.S. manufacturing through 2015 might enhance that capability, depending on whether

consumer products or heavier industries were the chief areas of expansion.

For the military economy to take full advantage of this stronger manufacturing sector, however, substantial adjustment would have to limit the present de facto separation of military and civilian manufacturing. The dynamics of that relationship will be discussed in more detail in a later section.

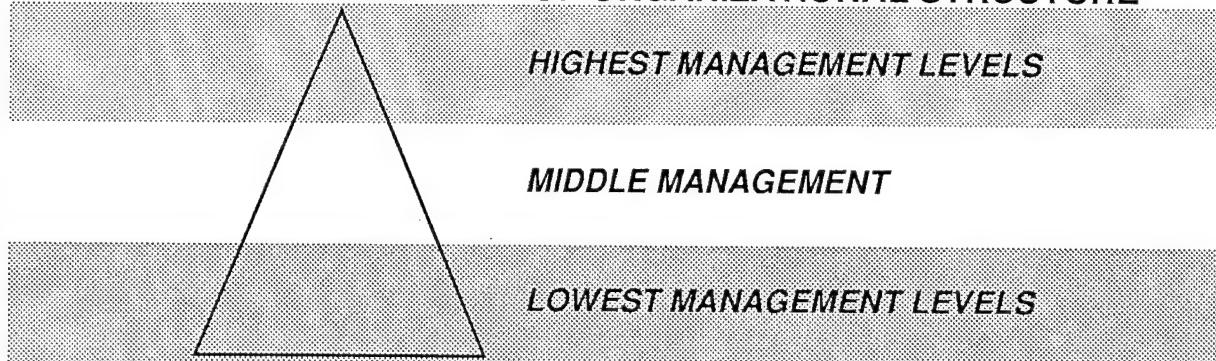
The impact of service sector trends on the military is less dramatic and direct. If productivity growth in that sector remains flat or negative in the next 25 years, however, U.S. economic power, hence international prestige, will diminish because of the continued influence of services on overall economic health. Conversely, if technological advancement affects enough major service industries in a major way, service productivity might begin to grow by 2 percent annually, providing an economic boost that would enhance the U.S. position after the year 2000. The outcome between those alternatives (likely to fall somewhere in the middle) will influence the flexibility of military funding and, conceivably, the geopolitical climate in which the military operates. The increased involvement of services such as communications, training, and information in U.S. manufacturing means that the productivity and technical proficiency of such services also has impact on the military. The degree of this impact will be determined by the degree to which military and civilian industry converge in the next 25 years. If the military economy remains essentially separate, changes in the civilian service sector will have less impact because functions such as software development and engineering and operation of computers and telecommunications equipment will be insulated from trends in the civilian economy. The advantage of such insulation may decrease if the civilian economy yields improved service techniques that might have to be re-invented at greater expense, or even foregone, on the military side. If substantial crossover occurs between the years 2000 and 2015, however, the efficiency level of those services in the overall economy can carry over into military applications.

## MANAGEMENT AND THE WORK FORCE

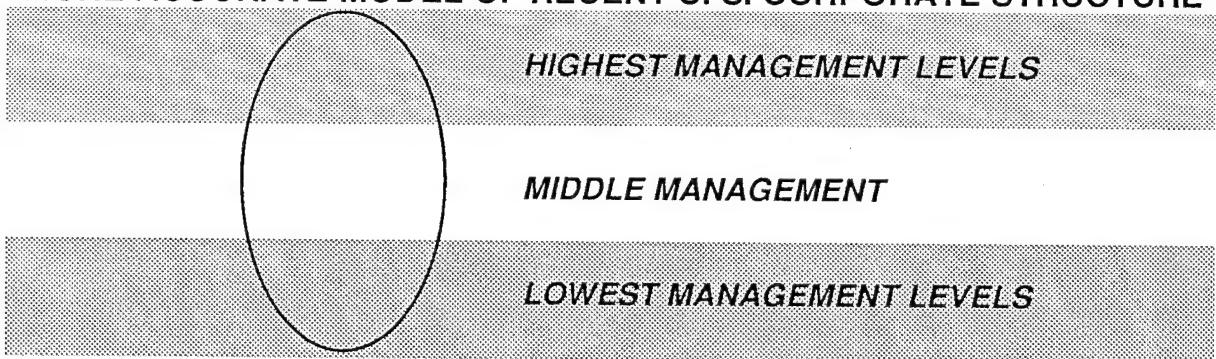
For a number of reasons, the conventional hierarchical management pyramid has been modified in many U.S. enterprises in recent decades. Figure 2 depicts how the pyramid is being modified. The middle management level of the pyramid is disappearing in two directions: part of it is simply becoming unemployed, another part is moving from purely bureaucratic functions to hands-on, "value-added" positions that emphasize direct decision making and operational control over personnel supervision. [68] The pyramid is being flattened partly to provide faster information flow to and from the top, to and from customers and staff. Reducing the number of organizational levels promotes teamwork, speeds product development, and allows flexible, rapid response to market changes. It also reflects the rising post-industrial concept that ideas themselves are products with economic value. The new structures often require supervisory and non-supervisory personnel, trained to function in diverse capacities, to cross the lines of conventional job descriptions. [16]

## **EMERGING MANAGEMENT STRUCTURE**

### **TRADITIONAL CONCEPT OF ORGANIZATIONAL STRUCTURE**



### **MORE ACCURATE MODEL OF RECENT U. S. CORPORATE STRUCTURE**



### **BELT-TIGHTENING HOURGLASS STRUCTURE NOW EMERGING**

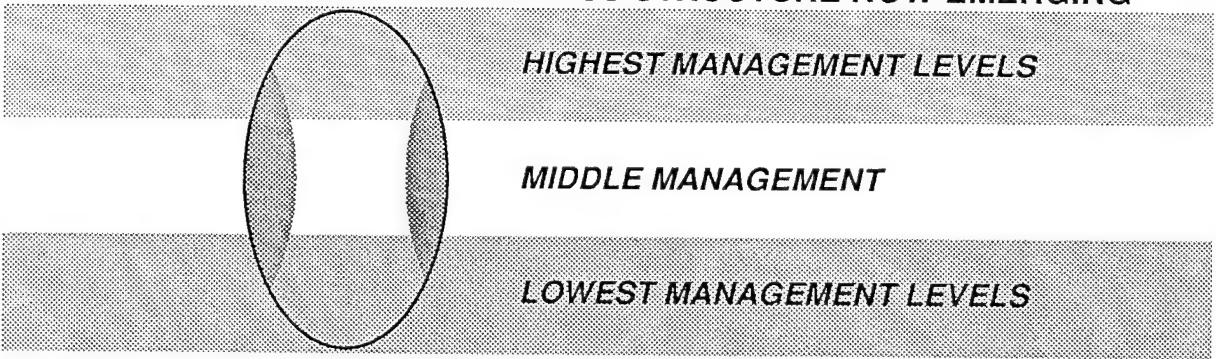


Fig. 2

In the next 25 years management positions are likely to undergo more qualitative changes. [79] Managers increasingly will be expected to be competent in a variety of skills, especially aware of market trends and new technologies, able to exert leadership and gather information outside the context of a rigidly defined hierarchy, and ready to share decision making with labor. As more information flows through automated channels than through human management structures, computer literacy becomes a prime requisite for managers. Also, a higher portion of management is likely to be women in the next 25 years--both because of overall workforce demographics and because of the breakdown of the male-dominated management pyramid. This will be especially true in the service and information industries. The rapidity of the last change will be determined by both economic factors (will it be possible for the average family to live on one income?) and social attitudes (will a traditionalist backlash pull some women back out of the work force?) [7]

Part of the basis of the management-restructuring scenario is increased input by labor into management decision making. An alternative scenario finds labor and management striving for greater cooperation and flexible organization in the name of improved competitiveness, but resorting to traditional adversarial labor-management relations when short-term profit-maximizing management refuses to take the risk of a new corporate structure. [55] While the traditional structure is resistant to change, foreign competition and the necessity that management gain all possible information input are drivers whose strength is likely to increase by the year 2000, leading to the triumph of the "we're all in this together" attitude.

The breakdown of conventional structures also applies to the work force. In the manufacturing sector, the use of automated equipment will be maximized in the next 25 years because in the long term it increases productivity, a key indicator of economic health. The main question here is the rate at which this process will proceed in the next 25 years. Between 1973 and 1988, the amount of labor man-hours required to produce a given volume of goods decreased by 150 percent. Because major manufacturing industries such as steel still held large amounts of conventional equipment in 1990, [72] the rate of replacement is likely to increase over the next 10 to 25 years. In this process, many job categories will simply disappear in the forecast period and leave a large group of workers unprepared for alternative employment in their newly high-tech industries. Many of those relatively high-paying manufacturing jobs will be replaced in the economy by lower-paying service jobs. According to one frequent prediction, both service and manufacturing job categories will divide dramatically into tedious, low-paying positions with little prospect for advancement and technical jobs requiring a relatively high degree of education or training. Jobs in the service sector show a more steady two-track, or bimodal, trend. A dramatic example of removal of a middle layer between those extremes is the "paper-shuffling" occupations (clerical, processing, and manipulation), which now are an estimated 16 percent of the work force. Given the scenario of rapid automation, this occupation will be largely replaced by information technology by the year 2000. [9]

Another scenario, however, severely downplays the bimodal outlook and foresees more gradual evolution in the structure of the labor force, mainly because of the huge initial cost of replacing labor-

intensive production with sophisticated, capital-intensive methods. This scenario would have robots performing only the most repetitive and hazardous tasks and thus replacing only a small fraction of the labor force by the year 2000, thus cushioning the social and economic shock of sudden conversion. [55]

Given a scenario of rapid introduction of technology such as information networks and robots into U.S. enterprises, the "shakedown" period in management and personnel structure might be ending by 2000. That would not mean the end of technological improvement in enterprises, but the slowing of human displacement by machines. In that case, the period through 2015 would be one of consolidation and fine-tuning for the human element of the U.S. production system. Given the scenario of technological transformation slowed by a shortage of investment funds (the rapid-automation scenarios most often omit the very high cost of the technological revolution that is to save U.S. productivity), prolonged economic downturn, or a lack of qualified technicians, the displacement process and its attendant insecurity and social disruption (see "Society") would be more gradual and extend into the 21st century.

Substantial shifts can also be expected in the quality and quantity of available labor in the next 25 years. The Bureau of Labor Statistics forecasts that by the year 2000, managerial, professional, and technical occupations will be the fastest-increasing employment categories. [79] But the proportion of such positions to the overall labor force will be determined by another driver: the extent to which "smart" machines eliminate the need for "smart" operators. Very likely that replacement will accelerate between 2000 and 2015, but its rate will be determined by the pace of technological innovation and onsite replacement of equipment. Meanwhile, people qualified in more than one of the premium categories (e.g. business and computers) will be in especially great demand.

Labor availability for the in-demand categories will be determined by several factors. Demographic factors will likely limit growth in quantity of U.S. laborers to around 1 percent in the next ten years, compared with 1.8 percent in the 1980s. (The same gross population factor will also limit demand in that period, another serious impact on the economy.) By 2015, however, the large number of women of childbearing age in the current population will cause a new jump in the number of young workers, who will also be consumers (see Fig. 3). [16] Within the gross number, however, other factors drive the participation rate of women, young workers, and older cohorts. The female labor force is likely to grow more slowly after dramatic growth in the 1980s, and a social backlash in favor of earlier motherhood and women in the home (see "Society") could slow the trend even more after the year 2000. If more older workers of the period (highly motivated baby-boomers still) elect to delay retirement, they could contribute stability and adaptability to the top levels of the work force. The number of trained young workers available in the next 25 years is problematic, however. Until about 2010, their age cohort is smaller than the one that supported economic growth by swelling the labor force in the 1980s. [31] But if the expense of college drives more prospective workers to shorter, skill-oriented training programs or directly to work, the participation rate of young people in the labor force would increase. [55]

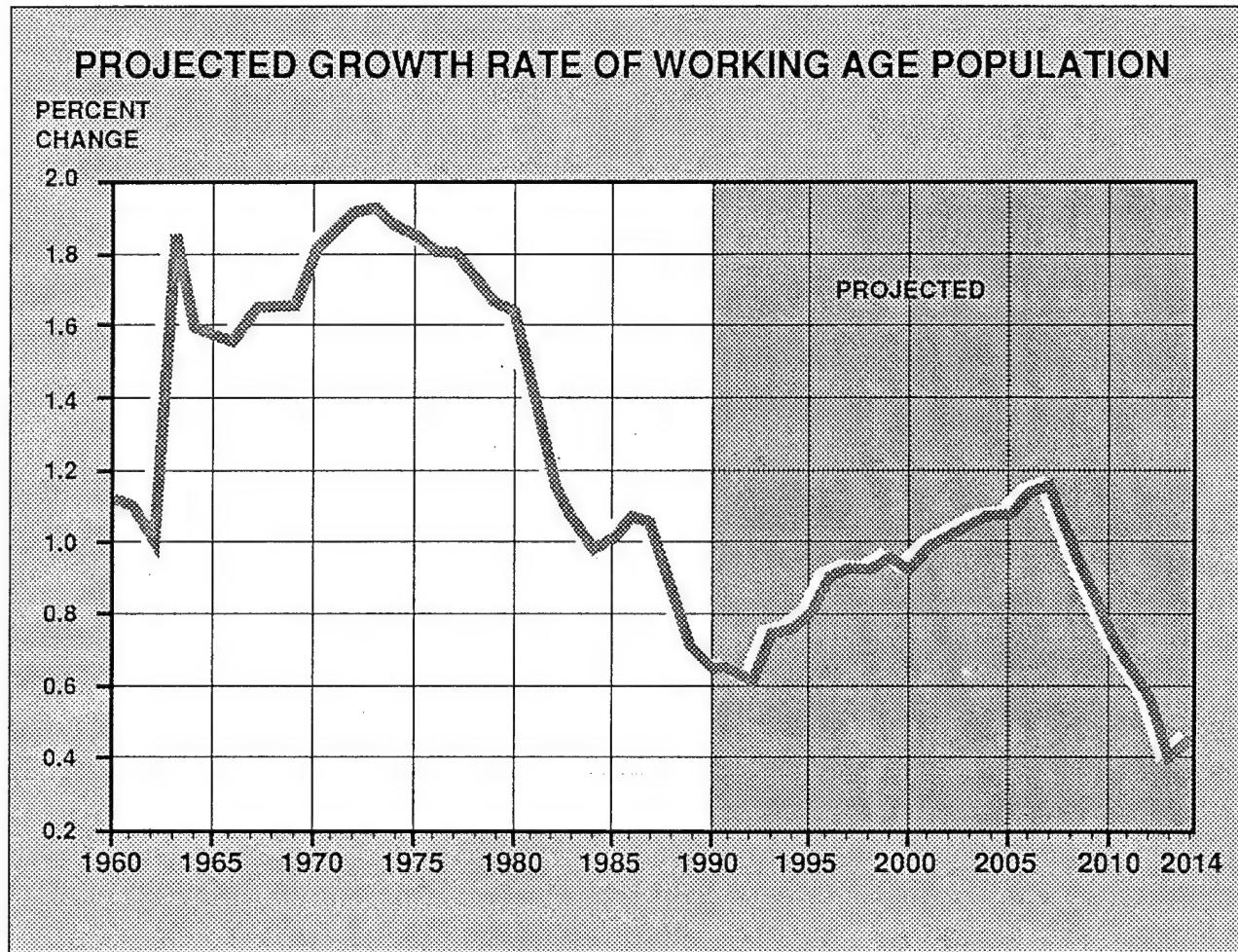


Fig. 3

An influential external driver here is the effectiveness of the U.S. education system in keeping pace with skill requirements in business, health services, information service, and finance. Conventional industrial on-the-job-training methods will have lost applicability before the year 2000. The expense of training new workers in basic skills in-house would decrease enterprise profits, slow productivity growth, and pressure enterprises toward more rapid automation to recoup lost productivity. But in fact, if increasing numbers of entry-level workers lack needed skills, precisely such a scenario might result. After a period of adjustment in such activity (ending around the year 2000, given rapid and relatively even automation in the intervening decade), enterprises may have streamlined in-house training to fill gaps left by the U.S. education system with minimal drag on productivity.

A wild-card variable in labor-force quality and quantity is the rate and source of immigration. The U.S. Department of labor projects that in the next two decades immigrants will provide 22 percent of U.S. labor growth, doubling the 11 percent contribution of the 1970s, when the baby boom augmented the domestic labor force. Because the next increase in domestic labor supply is not expected until nearly 2015, immigrant labor will be an important resource through the forecast period. As they have in recent decades, a large majority of legal aliens will likely gravitate to urban employment centers. In the forecast period, immigrants with entry-level skills will increasingly compensate for the relative scarcity of native-born workers in the 16-to-19 age group. But the labor force is augmented quite differently by Hispanic immigrants in the Southwest, for example, than it is by Asian immigrants in urban areas. Especially in the bimodal scenario, untrained worker groups would contribute less per capita to the economy than trained (or highly trainable) workers. In the 1980s, over one-third of U.S. immigrants had some college education. Dramatically increased, geopolitically-driven immigration from Eastern Europe or some part of Asia would serve to maintain that figure, which most analysts feel has been beneficial to the economy. [31] On the other hand, continued or increased Hispanic immigration from Central and South America might swell an untrained group to a size that would be a drag on the economy after the year 2000.

The increased emphasis on flexibility (a seemingly unidirectional trend) will affect both enterprise structure and the nature of the labor force. As many as ten job changes are forecast for the career of the average worker beginning a career in 1990. There is the possibility of creating a large, nomadic, "disposable" under-class of multipurpose workers in service industries specializing in short-term, customized work. Many of those workers may be trapped at entry level by their inability to remain in an organization long enough to develop marketable skills. Meanwhile, the skilled part of the work force will also change jobs and retrain more frequently, but more often as a voluntary step in career advancement. The rate of economic diversification and fragmentation will determine the rate at which such disruptions occur, but increasingly education will be the key to obtaining job security, mobility, and higher wages. [55]

How might these management and work-force scenarios influence Army policy? If average recruit age continues to increase, a larger percentage of the force will have prior exposure to the prevalent management structure of their time, which may be more antithetical than previously to military command hierarchy. An increase in the proportion of reserve forces would have the same effect. To

the extent that the understanding of authority is shaped by images such as the conventional corporate structure, future recruits will come equipped with a less homogeneous picture of how an organization identifies and achieves objectives. On the other hand, new enterprise structures may have provided them with self-confidence and initiative lacking in personnel emerging from a more conventional organization.

Work-force demographic changes will also have impact. By the year 2000 shortages of young workers will increase employment competition from the private sector for trained or trainable personnel, especially given a scenario where major parts of the service economy have moved into high-tech phases in the next decade. On the other hand, the bimodal scenario would mean larger numbers of available personnel whose skills match positions being abolished in the new economic structure and older workers unable to retrain after their traditional jobs have disappeared. On the average, such a pool of available manpower might be older and less educated, which might influence its attitude toward military service and its trainability.

## ENTERPRISE STRUCTURE

As already indicated, a major trend in the next 25 years will be fragmentation and diversification of production centers in both manufacturing and service sectors. Even large firms will be subdivided into multiple establishments forming production networks, rather than transforming raw materials into a finished product (in the case of manufacturing). Although the structure of such networks will vary widely, the general rationale for organizing enterprises in subunits is to achieve maximum use of energy and materials. [9]

In the 1990s, greatest growth is likely to occur in the number of small and large enterprises, with those of medium size growing less rapidly, just as they did in the 1980s--given reasonably even economic conditions during that period. Family firms (defined as those that have remained under control of one family for two or more generations) produced 60 percent of the U.S. GNP in 1989, and, barring a prolonged economic downturn in the next decade, the profitability and proliferation of such enterprises are expected to increase past 2000. This trend coincides with the economy's overall move toward closer contact with customers and more customization of service and goods, and with a tendency in society toward conventional family values and regaining control of financial levers, after a decade of takeovers and mergers created the perception of concentration of wealth in large, impersonal corporations. The small firm also provides challenging employment for white collar workers released in the management cutbacks of the large corporations. [23]

Evolution from larger units to smaller is not necessarily permanent, however. The 1990s will likely see great experimentation with enterprise size and especially configuration, corresponding to the introduction of entirely new product lines and production processes. For example, manufacturing operations may be merged with engineering and marketing operations, yielding a unified system of physical process with development on one end and the creation of economic value on the other. [33;59]

After adjustments in the 1990s, by the year 2000 individual industries may have established a pattern, dictated by some of the drivers already discussed: the need for rapid exploitation of new markets and new technologies, which would limit enterprise size and complexity but put a premium on flexibility; and, on the other hand, the need for large-scale investment in new capital equipment, which would favor a larger corporate structure. If regulations remain lenient, mergers and takeovers might also continue to diversify large parent corporations and make their production networks more complex.

Continuing mergers would mean that the predominance of large and small enterprises would continue because it is predominantly medium-sized companies that are consumed in mergers. Also, medium-sized companies (with, for example, \$100 million in annual sales) typically show the least productivity because their volume requires a substantial labor force but profits are not enough to afford full-scale automation. In the next 25 years, such firms will feel increasing pressure to increase capital investment at the expense of labor; those unable to do so will disappear or merge with others. [4]

The geographical siting of economic enterprises will also shift in the next 25 years. Manufacturing already demands much less proximity to natural resources and conventional transport (such as that provided by rivers and ports), and the day of material-intensive manufacturing is not likely to return. As a rule, services have always located near their customers. Given continued technical advancement in manufacturing and services, availability of skilled labor and communications networks will continue to be prime factors in enterprise location. This would mean continued concentration of high-wage employment around the metropolitan areas of both coasts, as well as certain parts of Texas and the Southwest and isolated points such as the industrial research centers of Michigan and Minnesota. [9] But in the next 25 years some regions will undergo boom-and-bust cycles. The frequency of that phenomenon will be driven by the intensity of foreign competition and the pace of changes in product lines in individual industries. Even the powerful Silicon Valley complex of high-tech industries now sees some enterprises threatened by Japanese competition that is expected to intensify before 2000. [15] By the year 2000 economic revival is possible in the Midwestern Rust Belt because of the affinity of high-tech industries for university research bases and the trend for individual states to make economic deals directly with foreign enterprises.

The fragmentation of the U.S. economy into smaller dispersed units could have various effects on the long-term health of the economy, and thus on resources available for military programs. Barring a long-term economic slowdown that would dry up the specialized markets they serve, the new small businesses can contribute a healthy entrepreneurial spirit ready to forego conventional production processes and managerial methodology. Their inherently "lean" structure would also help improve productivity in the manufacturing sector and enhance their contribution as subcontractors for military projects.

On the other hand, the dynamism of the small companies depends on a continuous investment flow, an increasing percentage of which will likely come from foreign sources over the next decade. The impact of foreign investment on the U.S. economy will be discussed more fully in a separate section, but the degree to which the economic structure remains fragmented in the year 2000 will be an important

factor in that variable: large numbers of smaller U.S. companies with leading edge technology could be under foreign control in 2000, potentially limiting their availability to military R&D. This is especially important assuming continuation of the present trend for major military contractors to disperse subcontracts widely among smaller firms.

Changes in the geographical distribution of U.S. enterprise centers will influence the demographics of military recruitment. To the extent that the mobile, young portion of the labor force relocates in the bicoastal economic concentration, attitudes brought from other regions will be homogenized in ensuing recruitment pools. In the Sun Belt, economic immigration will have the same effect on indigenous cultural patterns of the South and Southwest.

## **FINANCIAL AND INVESTMENT CONDITIONS**

Together with a slow rate of productivity growth, the unfavorable U.S. balance of payments, budget deficit (close to \$200 billion in 1990), and current investment patterns are most often cited in negative scenarios as evidence of long-term economic deterioration. Figure 4 projects GNP growth through the forecast period. There is a substantial consensus that the significant U.S. economic growth of the 1980s resulted mainly from consistently high foreign capital investment in the U.S. (\$329 billion in direct investment in 1988) [65], stimulated by the declining value of the dollar and the image of the U.S. economy as a secure investment. Since the mid-1980s, the U.S. has invested less in foreign economies than they have invested here; this borrowing imbalance, intensified by interest payments, becomes part of an already large U.S. trade deficit (\$128 billion in 1988). Also, a substantial part of U.S. foreign investment has gone to developing countries where the return potential is small; in the 1990s, substantial U.S. investment may go to Eastern Europe and the Soviet Union, also economically risky ventures (especially compared with the return potential for foreign investors in the United States).

Many also agree that long-term U.S. planning cannot count on such a foreign-investment trend continuing, and that a continued budget deficit (which has been at least \$150 billion for the last five years) will have long-term impact on domestic U.S. capital investment resources, barring a combination of higher taxes and federal program cuts having a drastic effect on the deficit. Wild-card items such as the S&L bailout are also de facto budget busters that have rather regularly disrupted recent budget forecasts and should be expected to continue.

Historically, long-term projections of a balanced budget have seldom come true because in the intervening period new or expanded government programs usually swallow more of the budget than was forecast. [26] Despite the prospect of a fiscally conservative national administration keeping programs such as food stamps and veterans' benefits at zero real growth through the 1990s, no federal surplus is likely to have supplemented available private investment funds by the year 2000--too many politically popular programs will exist. The ineffectiveness of the Gramm-Rudman procedures in paring budget deficits in the late 1980s supports that view.

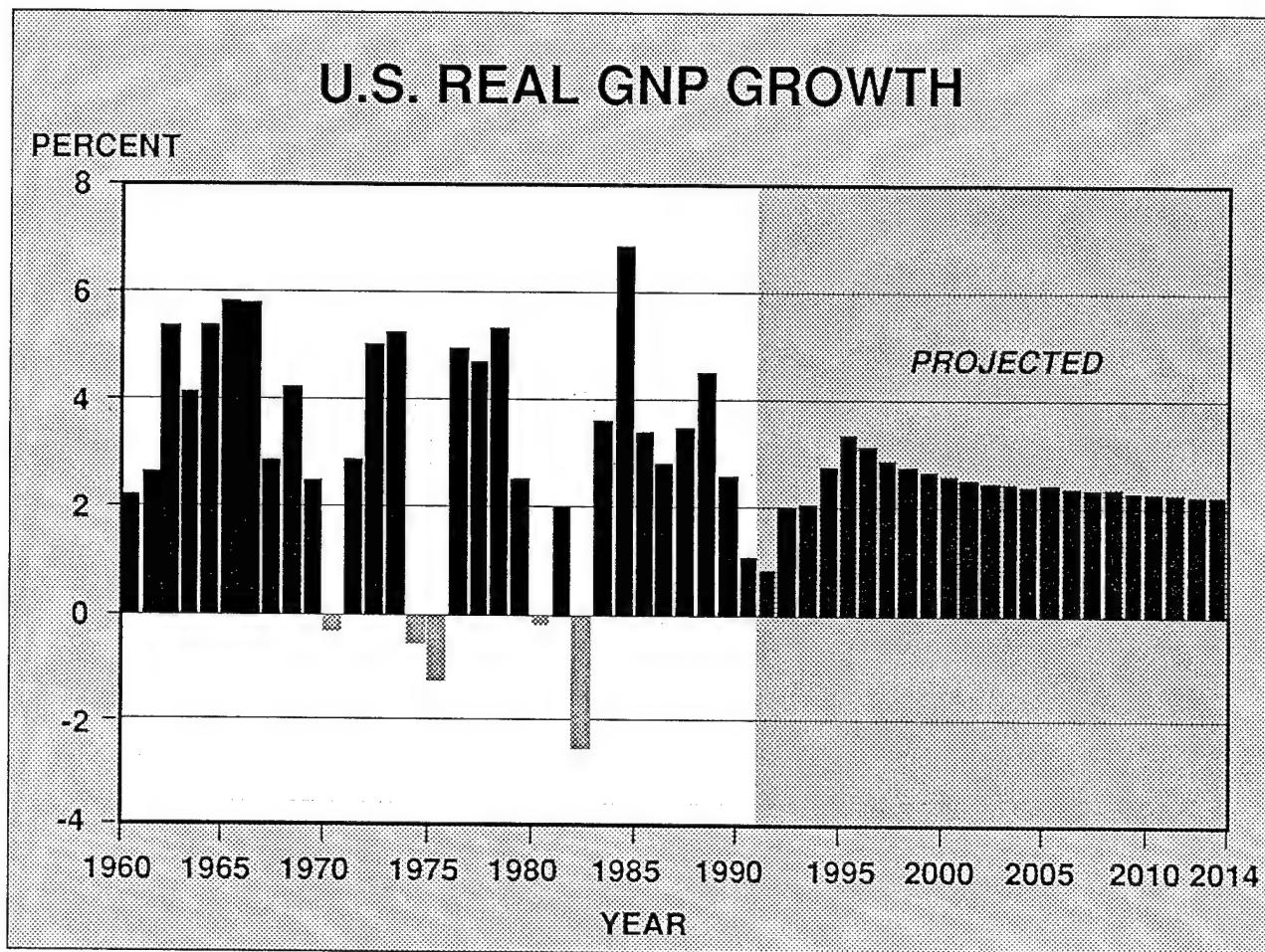


Fig. 4

Warnings about over-reliance on foreign capital are especially ominous when combined with another frequent criticism of U.S. economic priorities: that the U.S. stock-exchange-driven system encourages too much spending on consumption and short-term profit, too little savings and investment. In 1989 the U.S. savings rate was 14.9 percent of its GDP, compared with 25.8 percent for Japan. By contrast, consumer credit terms in the United States are much more lenient than in Japan and some consumption interest is tax deductible--diverting potential U.S. savings and raising interest rates for capital investment loans.

According to the interdisciplinary private Council on Competitiveness, in 1989 the United States was investing about half the percentage of GDP that Japan was investing in plant and equipment, and Japan's absolute investment total exceeded that of the United States that year as well, in spite of the much smaller size of its economy. [51] The disparity reflects a faster Japanese growth rate, rather than a lack of growth in U.S. investment; the "moderate projection" of the Bureau of Labor Statistics through 2000 calls for accelerated growth in the rate of U.S. investment in capital equipment, especially in communications and computer equipment, after an economic slowdown in the early 1990s. [79]

A result of the increased capital accumulation in that scenario is increased labor productivity, another statistical area where the United States has lagged in recent years, but where future projections vary considerably. Japan and Germany had virtually overtaken the United States in per capita productivity by 1990, having steadily closed the gap in the late 1980s. As in other indicators, a U.S. lag is not absolute but relative to performance of chief competitors; per capita productivity for U.S. workers rose \$13,000 between 1972 and 1987. [51] Crucial factors behind future productivity scenarios are labor distribution between low-productivity services and high-productivity manufacturing, absolute amount of available labor, and the pace at which capital investment lifts productivity by improving equipment. Progress in reducing the U.S. budget deficit will also play a role, both economically and psychologically. By the year 2000 interaction of those factors will likely show whether the optimistic productivity scenario (2 percent annual growth for the 1990s) or the pessimistic scenario (a continuation of the 1980s slowdown, to 1 percent or less annually) carries into the next century. In the latter case, output would not raise living standards or maintain government spending programs. Adjusted for inflation, average real hourly wages for U.S. workers have already been shrinking since 1973. [87]

Given no progress on the deficit, in the year 2000, the United States might still show prosperity in its productivity indicator, but the cost likely would be increased foreign debt and foreign-initiated foreign ownership of U.S. production facilities, and/or a U.S. industrial infrastructure unprepared by long-term investment for world competition between the years 2000 and 2015. Among non-economic drivers of the budget outcome are political feasibility of raising either income or consumption taxes, geopolitical feasibility of sustaining military spending cuts past 2000, and political feasibility of limiting the growth of entitlement programs in the U.S. budget.

A positive scenario combines adjustment of U.S. taxation policy to encourage domestic capital investment with sustained shrinkage of budget deficits--between 1993 and 2003, for example. The former change would likely cause a short-term, transitional economic slowdown, but if made in the next five

years would likely provide a solid production and R&D infrastructure for expansion after 2000. This position of relative strength would reduce dependence on foreign investment, placing more U.S. capital in strategic knowledge-based industries such as semiconductors, electronics, advanced materials, computers, aerospace, telecommunications, and financial services--areas where long-term investment will spill over technology to other industries past the year 2000. [77;84]

At some point before 2000, incentives for foreign investment in the United States are likely to weaken; barring world economic crisis, drivers of this scenario are increased attractiveness of the European Economic Community (EEC) or Asian economies as investment ventures, long-term currency valuation shifts, or politically-driven economic policy changes by major investors such as Japan and the United Kingdom. If that happens before U.S. investment policy has shifted, a major economic crisis might result, especially given the likelihood that U.S. manufacturing will then be committed to a major retooling process. Given that scenario, the period 2000-2015 would likely be a recovery period marked by forced rechanneling of domestic funds into targeted industries and services--a drastic weaning from foreign borrowing and the present policies that encourage low savings and investment.

In terms of impact on the military, continued growth in foreign investment in the United States through the year 2000 would mean a shrinkage in the enterprise pool available for military contracts--not because foreign ownership per se is a disqualifier, but because the cumulative security risk grows with the percentage of foreign capital. The short-term slowdown impact of rearranging domestic investment incentives would likely be cushioned in the specialized military sector, and beyond 2000 (positing a rearrangement sometime in the mid-1990s) such adjustment would ensure broader availability of military technology from the U.S. economy. A recovery from the budget deficit will almost surely involve severe military budget cuts in the 1990s and a continuation of reorganization and prioritizing past 2000 (although the outcome of Operation Desert Storm uncovered substantial remaining enthusiasm for expanded military spending). The existing trend of withdrawal from military production by U.S. enterprises would accelerate if funding shrank. Given relatively smooth conversion to a consistently smaller military portion of GNP (to as little as 3.6 percent after a peak of 6.5 percent in the mid-1980s), by the beginning of the forecast period the Army will have had several years of adjustment to operating with fewer resources. In that scenario, by the year 2000 austerity would likely force procurement of "off-the-shelf" products, which will be discussed in a later section.

## THE UNITED STATES IN THE GLOBAL ECONOMY

Accelerated international economic integration in the next few decades is a scenario accepted in one form or another by virtually all forecasters. The dramatic 1992 removal of economic frontiers within the EEC is perhaps the most immediate example of smoothing the passage of goods and services among nation-states. But the 1990s will likely bring equally dramatic changes in other parts of the world: addition of Mexico to the U.S.-Canada free trade agreement is under serious discussion, [49] and that

grouping could lead to complete economic unification of the Western Hemisphere, or, farther in the future, a Pacific Rim grouping including Asian industrial powers. [7] Newly industrialized countries (NIC's) have revised the world economic flow by taking over basic mass-production operations. This means that even after EEC unification, a number of major economic players (Japan, South Korea or a reunified Korea, Taiwan, Singapore, and Brazil) will remain dispersed geographically and economically, likely contributing an increasing variety of products to the world economy. Growth rates in the Asian NIC's will likely remain substantially higher than those in the EEC well past the year 2000. [70]

Given continued development of international information transfer, in the next 25 years national economies will be interconnected and mutually dependent to an unprecedented degree, whatever their location or formal alignment. In that scenario, geography ceases to be a controlling economic variable because the conjunction of computers and telecommunications systems provides instant information access. Industrial processes, much less dependent than previously on material availability, can be located where labor supply and retail markets are most favorable. [14]

Among the implications of such a scenario is the internationalization of capital: movement of money among national economies less influenced by individual government policy than by the interactions of the international money market and its operatives. This means that traditional control of a national currency may not be available to nations, including the United States, as a lever of international power. Markets will no longer have fixed locations; they will be rather communications networks with access points all over the world. An example is the spot oil market, formerly located in Rotterdam but now functioning as a computer-linked network of brokers all over the world. Such internationalization leads to a certain lack of national or international legal control over economic activities (such as establishment of oil prices), which has deep significance for the economies of nation-states. [14]

Under these circumstances, enterprises formerly located exclusively in one country will continue to spread their operations (and their investments) to other countries, forming joint ventures or other multinational arrangements because of the following advantages: such arrangements offer a share of foreign markets, they divide the cost of research and production, and they give access to top-level foreign technology. An example is the proposed joint venture of Boeing with the French Aerospatiale and German Deutsche Aerospace firms to develop a new supersonic transport plane in the 1990s--an arrangement that may mean transfer of sensitive U.S. technology. On another level, the Singer Company of Connecticut now buys sewing machine motors from Brazil and machine shells from a separate U.S. supplier, while devoting all its domestic production facilities to aerospace. Under this arrangement, its share of the world sewing machine market increased in the 1980s. [50] Already in 1991, over half the goods manufactured in the United States contained at least one component made abroad, and half of U.S. trade deals occurred between U.S. companies and their foreign branches or parent companies. [36]

Driven by the unprecedented freedom to choose, the configurations of foreign and domestic enterprise elements are likely to continue multiplying through the year 2000, in both U.S. and foreign firms--in inverse proportion to national barriers placed on technology exchange and trade. This context poses new aspects to the long-lasting U.S. dilemma captured in the political buzzword "competitiveness."

In recent decades, significant parts of industries such as electronics, computers, steel, and machine tools, many defense-vital, have lost markets to foreign competitors, moved operations overseas, or been purchased by foreign enterprises. The graphs in Figure 5 show these trends in selected industries over the last decade. In 1991 the private Council on Competitiveness found that, although the United States retained its world position in 61 "technologies rated crucial to economic prowess," its loss of position in 33 others was cause for alarm and development of new government strategies to bolster crucial industries. [87]

A major question, already touched in this paper, is whether such reports signal actual decline in U.S. economic power, or whether they are the natural outcome of unprecedented diversification and technological change in the world economy. The disparity of answers to this question is conditioned by differences in philosophical approaches to national and international economics, and by the importance given to the advances of competitors who have approached international competition differently than the United States. For the U.S., the 1990s are likely to be a period of intense strategy discussions and adjustment. By 2000 a modified approach to international competition and globalization will likely emerge and prevail through the early decades of the 21st century, but the nature of that approach is not yet clear.

In spite of significant domestic political backlash against Japanese investment and trade practices in the 1980s, the U.S. approach to the "competitiveness crisis" (which threatens to become a major political issue) has been to support free trade, discourage protectionism wherever possible, and, in the name of eventual free world trade, minimize the importance of the aggressive trade strategies of competitors. An example is the plan for a North American free-trade pact including Canada and Mexico, widely opposed by U.S. labor and farm groups who demand protection of U.S. jobs from cheap Mexican labor. Advocates of the plan foresee expansion into new markets for all three economies as a first step toward total economic integration of the Western Hemisphere. Such a plan is a model of the multilateral benefit viewpoint that sees globalization as requiring that at least part of U.S. economic policy now focus on building world prosperity, which will inevitably reverberate in additional revenues for all those participating. In that process, some short-term sacrifice of U.S. jobs will likely be necessary, but that is seen as a natural component of the free-market system.

Anti-protectionist, free-trade political forces seem ready to dominate the national U.S. scene at least until 1996. Meanwhile, in the late 1980s three separate national-level competitiveness councils were formed, each evaluating economic evidence from a different standpoint. One of them, the private Competitiveness Council, has called for substantial increases in government direction of key industries. For the competitiveness situation beyond the year 2000, this proliferation of advisory groups may merely represent the deep institutional and philosophical divisions that block consensus on a problem whose dimensions have not been assessed yet; or they may show an emerging national perception that competitiveness is ultimately a top-level national security issue. The relative influence of such advisory panels in the philosophical shakedown period of the 1990s should indicate where U.S. competitiveness policy will be in 2000 and beyond.

## U. S. AND FOREIGN COMPETITION IN SELECTED INDUSTRIES

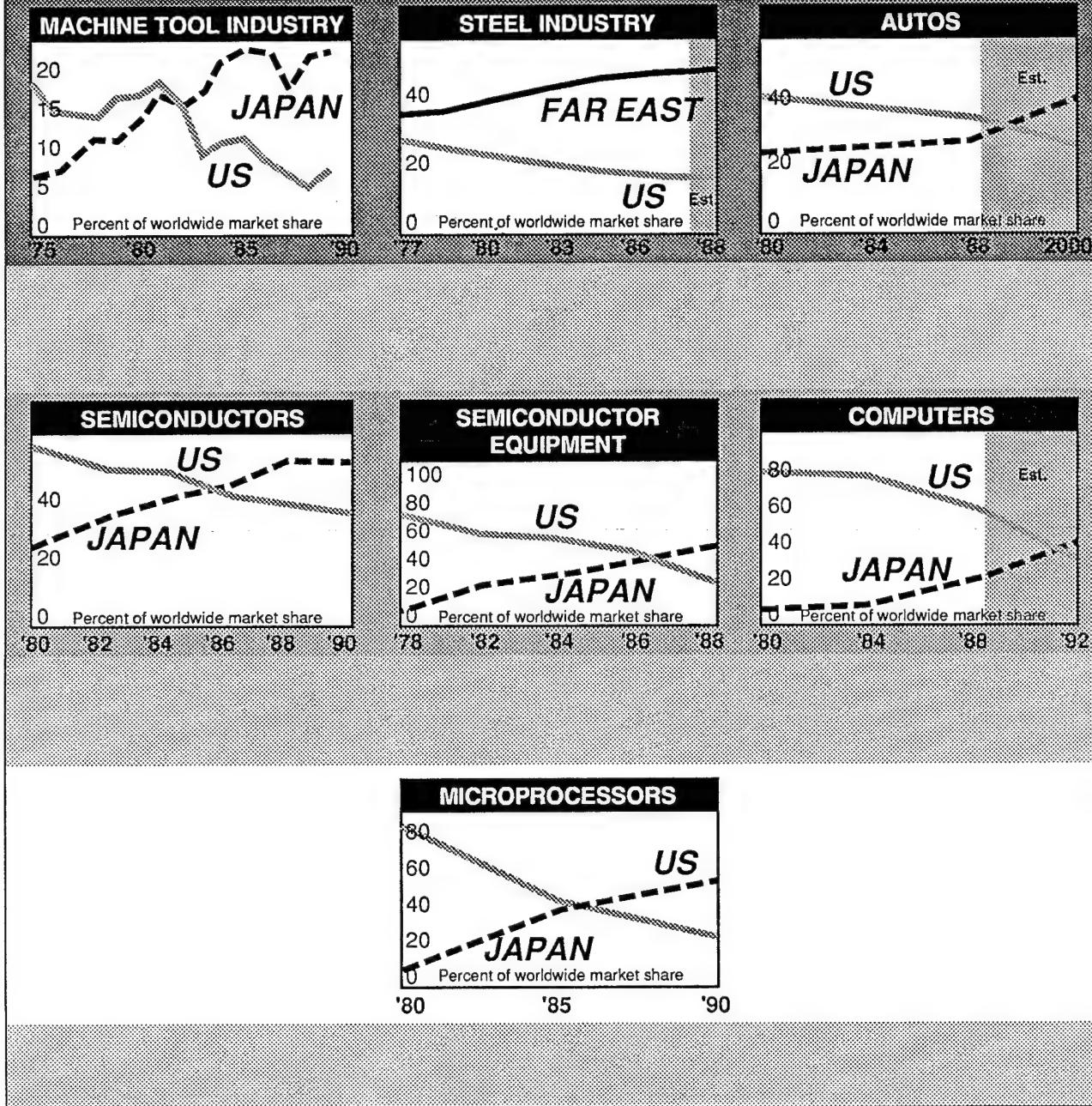


Fig. 5

Meanwhile, in The Work of Nations economist Robert Reich extends the multilateral benefit scenario, predicting the end of national economies and the irrelevance of factors such as national investment sources and destinations, location of production facilities, and national trade balances. In this scenario, the health of the U.S. economy, for example, no longer depends on that of the U.S. corporation. In making the conventional debate over economic competitiveness irrelevant, however, this view assumes (unrealistically?) a concurrent withering of other forms of geopolitical competition that might interfere with cosmopolitan harmony.

Present U.S. economic policy also encourages free domestic enterprise, in opposition to various proposals for government or quasi-government direction of industrial policy. The rationale of the present policy is that, even though aggregate performance of a critical industry may lag, parts of that industry likely are performing well; government interference or control will discourage initiative and competitive enthusiasm in those parts. [84] Unlike Reich's view, this policy depends on the continued vitality of conventional national economic units acting independently. Government's role is as an umpire, to maintain optimal conditions for entrepreneurial innovation.

Critics of a domestic free-enterprise approach point to the Japanese and European examples of cooperation between state agencies and private enterprise, as streamlining investment targeting and promoting consistency in long-term commitment to technological processes. Savings rates, R&D, and human resources development are said to be among the beneficiaries of such a policy. According to this view, before the year 2000 competition with countries thus equipped will become increasingly difficult for totally independent U.S. companies in the most desirable markets. [51;16]

If the United States should reach 2000 in an obviously deteriorating international position because of continued low productivity, high budget deficits, an outmoded infrastructure, or some combination of those elements, two patterns of action may emerge. As already mentioned, protectionism will be pushed (by organized labor and other influential factions) as a weapon against aggressive trade practices by foreigners. Pressure will be especially strong if a limited world market tends toward the zero-sum model (unchanging amounts of available goods divided in varying portions among world economies) instead of the scenario of multilateral benefit from an ever-expanding world economy. The "deflationary" scenario would mean abandonment of productivity growth as a goal, reduced capital investment, and emphasis on preserving traditional industries and jobs. On a world scale, it would also re-emphasize national economic units, as nations ended cooperative policies to secure their share of limited markets.

Targeted economic policy, which has been proposed for the United States in many variations of private and governmental control mechanisms, would establish a consensual regulation system that would move the U.S. economy toward a partnership among government, business, and labor that was closer to that in Japan and Germany and reshape the conventional adversarial relationship of those three institutions that now permits only limited "watchdog" government regulation. [41]

The latter policy runs counter to cultural values of individualism and competitive spirit strongly ingrained in U.S. society and prevailing political opinion against government interference in the economy. Barring a major political shift, there is little prospect that policy targeting will be applied broadly before

2015. If a major shift away from current laissez-faire policy (domestic and/or international) is required in the year 2000, public perception of the U.S. position and the threat of international competition (will Japan still be an easily identifiable villain, or will competition be distributed more subtly among the EEC and several Asian countries?) will be an important driver of policy choice between the years 2000 and 2015.

The impact on the Army of various scenarios of future world economic cooperation and rivalry is discussed in "Geopolitics." An influential aspect of a new U.S. position in the "global economy" is the increased mobility of defense-vital enterprises among two or more countries, when the sale or relocation of R&D or production facilities elsewhere becomes economically attractive. The threat to military procurement of the resulting redistribution may depend on the degree of concentration of such activities among foreign enterprises because concentration reduces supply alternatives. To meet this threat, the "4/50 rule" has been used in evaluating purchase of national-security-vital enterprises or facilities by foreign buyers: if over half such an industry would thus come under control of four or fewer foreign enterprises, a purchase may be blocked under this formula. Control of such moves, however, is problematic given the complex of regulations and policies that now govern commercial transactions with foreign enterprises. The Committee on Foreign Investment in the U.S. (CFIUS) was founded in 1988 to determine the national security ramifications of certain industries coming under foreign control. Because the definition of "national security" has been vague, this organization has not had administrative "teeth." [36] This factor combines with poor domestic investment and tax incentives and inappropriate technology export laws to drive some defense-critical enterprises abroad. A result of that combination of circumstances was seen in the Persian Gulf War, where the U.S. military was totally dependent on French and Japanese firms for certain vital spare parts. [14] Continuation of domestic and external laissez-faire policy well into the 1990s, given continued aggressive economic policy by international competitors, would seem to promise more such incidents.

Under even the most positive scenario, the defense industry will likely face purchase of critical materials and equipment from non-U.S. sources between 2000 and 2015, for two reasons: a strong commitment to a wide variety of advanced technology in military hardware, whatever the force size; and the momentum of economic globalization, which will continue to move critical producers of at least some of that advanced technology irretrievably beyond U.S. control, no matter how strong the domestic economy.

A U.S. protectionist policy after the year 2000 would likely constrict the range of military procurement, especially given the likelihood of increased U.S. reliance on technology to offset manpower loss in the 1990s. A response to this would be increased government sponsorship of targeted R&D programs and/or production facilities, incorporating civilian industry and academic research centers into mixed defense enterprises whose political justification would be impending crisis in national security. Such a crisis might be very real if a re-emphasis on self-sufficiency brought higher cost, lower production, and delayed deployment of defense systems—dangers inherent in shrinking the production base. [36]

An alternative scenario would be comprehensive analysis during the 1990s of presently disparate elements of tax law, procurement rules, R&D policy, and technology transfer policy in the context of the present and future global market. By the year 2000 such an analysis might begin producing an up-to-date, focused national policy that would insulate military procurement from the most insecure elements of foreign supply and stabilize its R&D base. The former might be done by ensuring that foreign suppliers are as widely dispersed and competitive as possible, the latter by supplementing private investment in the high-risk stages of cutting-edge technology development. [36] But the most likely short-term driver of such a development is a military emergency in which, unlike the Persian War experience, foreign supply of equipment is not forthcoming.

Perhaps the most likely scenario is a part-way U.S. commitment to targeted investment in R&D, capital equipment, and training programs, on a "special need" basis, by 2000. Using the precedent of the space program, such an approach could be politically feasible because it would not visibly foresake the free market philosophy. It would likely seek to bolster U.S. competitiveness in defense-vital industries such as semiconductors, electronics, and machine tools. Using a narrow definition of national security, this approach might be a "fix" that would support U.S. military suppliers past the year 2000. But it might well fail to address broader issues such as low savings and high consumption rates, which ultimately shrink the amount of investment funds (public or private) available for either targeted or general use. And the implicit protectionism of such targeted support may increase military procurement prices in the same way that automobile import quotas increase car prices.

## THE MILITARY AND CIVILIAN ECONOMIES

A frequent near-term prediction is that in the 1990s the military will reduce its personnel and extend its reliance on advanced technologies such as semiconductors, advanced communications and software. But, given the acknowledged prospect of a shrinking military budget, the economics of procurement of such technologies, as well as weapons systems and other equipment, will receive close attention in the 1990s; by 2000 a process of drastic revision may be well underway.

By 1991 defense production was virtually disconnected from the civilian economy. Although military projects have an impressive record of spinoff contributions to civilian technology (such as satellite communications), little technology now flows out of the labs of military contractors into the civilian sector, and military production is increasingly incompatible with technologies and production methods in analogous civilian operations. [13] Although the military share of federal R&D spending remains steady at 67 percent, the part of that devoted to basic research, the area most likely to have civilian application, has dropped from 6 percent to 2 percent [20], and at the same time industry-funded R&D has decreased (see Fig. 6). Instead of spinning off advanced technology, military production is now a net recipient of technology. [45]

Military specifications have become very precise and unique, performance requirements tend to

override cost and durability factors, and the bureaucracy of paperwork and regulations surrounding military procurement has become overwhelming. Congressional oversight limits sector overlap in the name of military cost control, and the military insists on the right to transfer technology to contractors' competitors if national security requires it. For all these reasons, the U.S. producers of military equipment have been pared to a unique group of companies equipped to deal with such requirements. According to the Center for Strategic and International Studies, 68 percent of firms providing military goods in 1982 were no longer doing so in 1987, despite significant increases in the defense budget during that period. [13] Most firms that have both civilian and military production operations have carefully separated the two.

Many have proposed breaking down the barrier between military and civilian production in some way in order to allow the military to take advantage of dual-use and cost-saving technology and the many R&D areas in which civilian production moved ahead in the 1980s, and also to allow civilian industry to profit more from the 67 percent of federal research funds going to the military. The urgency of reorganization is reinforced by numerous examples of production inefficiency, cost overruns, and lack of backup production capacity in the military as well as by a perceived lag in civilian R&D compared to foreign competitors.

Among suggested innovations in the military economy are adopting the design-to-cost approach of the civilian sector, in which product performance is maximized only to the point the market will bear its cost instead of driving up cost dramatically by insisting on the absolute maximum performance; continuing competition among contractors throughout production of an item, forcing them to compete for annual sales shares rather than incurring uncontrollable production cost increases; changing specifications to minimize component specialization and allow use of off-the-shelf commercial parts that have already been market-tested for both performance and cost; and finding uses for production capacity idled after completion of specialized military projects.

Substantial institutional drivers would resist such reforms, in spite of the foreseeable likelihood of spiraling procurement costs. First, restructuring the relationship of civilian and military industry would require a federal coordinating body with a long-term mandate and close connections with industry--a bureaucratic entity sure to be attacked on the same grounds as was a comprehensive national investment policy, as government interference in the free market. Second, forced diversification and competition for defense contracts would be opposed by the powerful companies remaining as defense suppliers, who are already lobbying hard to retain contracts in a budget crunch. [67] And third, there is now an ingrained assumption in government and the military, codified in a mountain of defense regulations and directives, that unique military specifications are the norm rather than the exception in guiding defense production. [37] In even the most positive scenario, to dissolve such institutional obstacles would require an integration strategy lasting through the 1990s. This fact means that the effect of any such strategy begun in the next few years would be first seen in the defense systems initiated between the years 2000 and 2015.

## INDUSTRY FUNDED RESEARCH AND DEVELOPMENT UNITED STATES, JAPAN, AND WEST GERMANY

PERCENT

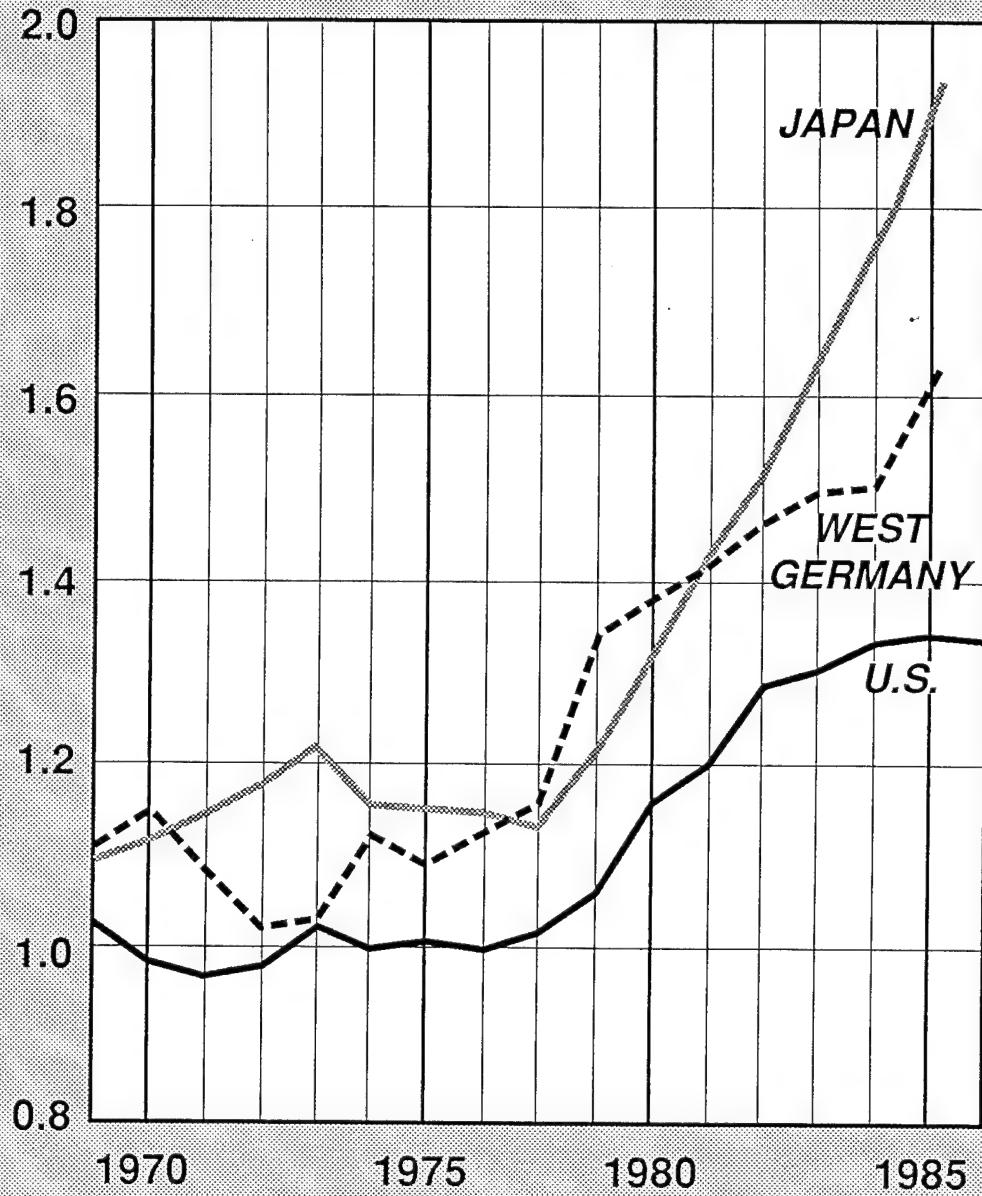


Fig. 6

In the 1990s, the cost driver may well overcome institutional obstacles if the design, development, and manufacture of weapons systems is as cost-inefficient as most critics claim. Another potential driver is a shift toward standing U.S. forces with lighter equipment, emphasizing communications and light vehicles. That development would broaden procurement potential of off-the-shelf equipment, but it would also require greater civilian capability to shift to production of weapons systems in the event of a major conflict--something the civilian economy cannot do at present. [45]

Were a substantial degree of civilian and military industrial reintegration to be achieved by 2000, a more flexible approach to procurement would be possible after 2000. Instead of the current "pipeline," leading straight from R&D to the fielding of a specific system, emphasis could fall on evolution of existing systems as required by geopolitical and budgetary conditions. Such emphasis would be possible because the methodology of the defense economy would resemble more closely civilian enterprises in design approaches, procurement practices, and cost sensitivity--making the military market a reasonable area of expansion for civilian enterprise and giving the military a wide range of ready, cost-effective alternatives. Reintegration would be especially useful given a scenario of proliferating small enterprises capable of producing customized high-tech items. Such a constructive relationship likely would be less possible, however, if reintegration were achieved because government agencies pressured parts of the civilian sector to adapt to the unique requirements of military production. [37]

## UNRESOLVED ISSUES

The U.S. economic situation will be influenced by a number of factors, internal and external to it, whose resolution are unknown and unknowable at this time. Among them are the degree of constraint to be exercised by environmental legislation on production, and the impact of environmental change on U.S. production centers; the role of independent economic policy making by economic organizations at the state level; the capability of the U.S. government to make major changes in current attitudes to economic planning, if necessary; future U.S. public attitudes toward the "competitiveness issue," consumption, and women in the workplace; geopolitical conditions requiring varying degrees of economic support for the military; and the degree of U.S. cultural adaptation to globalization.

In 1990 U.S. statutes such as the Clean Water Act and Clean Air Act contained provisions for more stringent controls on industrial pollution, requiring installation of expensive purification equipment in plants. The Clean Air Act targeted small polluters such as gas stations and dry cleaners for the first time in 1990. In the 1990s, public concern about acid rain and the increasing likelihood of global warming will likely increase, in opposition to the accepted societal value of unimpeded economic growth. Beyond that, however, the actual long-term effects of those phenomena and other types of persistent environmental degradation may be felt much more sharply after the year 2000--especially if for some reason strong international measures are not taken in the interim. In that scenario, before 2015 U.S. coastal population and economic centers and agricultural patterns might feel major climatic impact, and

pollution might become a divisive issue among bordering countries such as Canada and the United States and the U.S. and Mexico. The timeliness and appropriateness of environmental measures in the 1990s will determine the severity of such disturbances in the forecast period and beyond.

Given strict enforcement (not the norm before 1990 but seemingly more likely through 2000), U.S. industry would invest billions of dollars to meet requirements, diverting funds from major infrastructure improvement. The other side of the environment question is that valuable new technology and processes, some perhaps with military application, result from the drive for clean air and water. The extent of the positive and negative sides of the environmental factor will depend on the perceived margin available in the economy for upping environmental standards, in combination with public attitudes. In a prolonged downturn, both government enforcement and technological innovation would presumably slow. An aspect of the environmental question especially important to the U.S. economy is the technology of waste material disposal. In the age of independence from material requirements for manufacturing, this largely unresolved problem is one of the two remaining obstacles (the other being dependence on conventional fuels). New solutions in waste disposal would remove a major constraint on industrial location and streamline production processes, while the lack of such solutions would detract from the overall technological upgrading expected in the next 25 years.

In spite of a consistent U.S. position against government participation and interference in private enterprise, many states have formed partnerships with the private sector and begun to solve locally many of the national problems listed above. For example, the Ben Franklin Partnership of Pennsylvania, run by the legislature and representatives from labor, education, and business, uses state and private funds to stimulate development and marketing of technology. And the Corporation for Indiana's International Future, under a similarly diverse administration, identifies and promotes state industries with foreign export potential—one of several state organizations now making direct export deals with foreign countries. Now operating on a relatively small scale, such agencies may have significant impact on the national economy in the next 25 years, and their success could stimulate revision of national policy. [44]

A related question is whether the U.S. government is fundamentally able to run a comprehensive national "industrial policy." Several observers have noted that an industrial policy already exists in the hodgepodge of regulations, taxes, and subsidies enforced by various agencies. The tobacco industry, for example, is simultaneously taxed, restricted, and subsidized. Given the diversity and traditional independence of U.S. business enterprise, even targeted policy-making control may be infeasible. In spite of frequent calls for government activism in the "competitiveness crisis," a workable organizational form of such activism remains problematic.

Another imponderable are changes in U.S. political and societal attitudes on economic issues: what importance will the public assign to international competitiveness in the election of 2000? How will that evaluation affect support for the aforementioned increase in government control of private enterprise? Will there be a full-scale social backlash against the idea of working mothers and the consumption patterns of the 1980s, and will it be followed in the next decade by an opposite reaction? The public attitude to competitiveness will depend partly on actual economic conditions in 2000 (Will the standard

of living have dropped appreciably by then?), partly on the arcane process of issue identification by politicians. Then, if competitiveness becomes a major issue, will the public accept quick-fix solutions (such as trade barriers) or demand fundamental changes in education and industrial infrastructure? Public attitudes toward certain social issues will affect the work force and the orientation of U.S. manufacturing. Although women made a major contribution to work force expansion in the 1980s for both economic and sociological reasons, re-emphasis of family values might cause many to re-evaluate career decisions in the next 25 years, with possible serious impact on management and the skilled labor force.

In another area, the shape of consumer production in many categories will likely be altered by a combination of increased environmental consciousness and a related backlash against previous consumption levels--but the impact of both those factors has wavered in recent times. Judging by trends in the last 15 years, the period 2000-2015 will likely see at least one major swing in public attitudes on women's and environmental issues and on consumption levels, but the starting and end points of such a swing are unknown.

Geopolitical issues and conditions will continue to influence strongly U.S. economic policy. A major factor here will be the degree of U.S. energy dependence on the Middle East (see "Resource Picture"). Whatever political alignments exist there between 2000 and 2015, continued dependence on imported fuel would be a major economic weakness in that period and could lead to additional expensive conflicts in the region.

Another unanswered question in this area is the geopolitical fallout of the new international economic blocs that will likely form in the 1990s among industrialized nations. Even if those blocs provide economic growth for all their members, substantial parts of the traditional Third World, and even perhaps parts of Eastern Europe, will likely remain outside direct range of such benefits. Supporting them economically, or even combatting armed uprisings by them, would reduce substantially the health of any new world economy. And a scenario of intermittent failure or conflict within the new economic blocs would worsen the prospects of dealing with the "have-not" nations.

Finally, reaping the benefits of globalizing the U.S. economy across a broad spectrum will likely require substantial cultural accommodation and some compromise of the U.S. values of economic independence and entrepreneurial freedom. Items such as learning foreign languages and adopting foreign customs will become much more important. Ultimately the U.S. education system will determine how those values change, but change is needed in the generation now making economic policy as well. Understanding of competing national approaches to economics, if not compromise with them in U.S. policy making, will be necessary for the United States to be a full partner in the globalized economy. An especially constructive starting point would be Japan, toward which U.S. attitudes of fear and hostility have been formed without complete understanding of that alien culture. But the culture shock of no longer being able to "go it alone," absorbed only slowly to this point, may linger past the year 2000.

## CONCLUSION

Whatever trends emerge and whatever drivers prove most influential, in the year 2000 the U.S. economy will have undergone a decade of intensive, often painful readjustment. Most parts of the economy, including the military, will share in that process. Both the goods-producing and service sectors will have substantially more automation in 2000, but the nature of the automation process in the forecast period will depend on several variables: whether a point of minimum human participation has been reached, where further automation is not cost effective; how much investment capital has been available in the 1990s for retooling; new government approaches to investment that might speed (or deter) the retooling process in the forecast period; the number of skilled positions required in new automated workplaces, compared with the supply of skilled labor after 2000; and the influences of foreign competition: the stimulus to match foreign advancements and the impact of losing goods-producing jobs overseas.

Structural changes will continue in the work force, management, enterprise configuration, and the balance between services and goods-producing enterprises. In the work force, these changes will be influenced by demographic factors such as age-cohort distribution, quantitative and qualitative changes in the female work force, and immigration patterns; stimuli and disincentives for higher education; changing lifestyles for older workers; availability of business- or government-supported apprenticeship programs; and the relative distribution of jobs over a period of time between skilled and unskilled positions. In management, important change drivers will be the speed at which automated information systems make traditional mid-level positions redundant and physically disperse enterprises; degree of resistance to concepts such as flexible labor-management teams and multiple-skill management; the fate of the small, independent entrepreneur/manager after 2000; and the cumulative impact of repeated instances of white-collar displacement in economic downturns before and after 2000.

In the balance of goods-production and services, important factors are the speed and resource availability of capital equipment replacement, which will help determine the sector's contribution to GNP in the forecast period; political decisions on protecting some industries from international competition and subsidizing R&D and capital investment in security-vital industries; the impact of free-trade agreements on job losses in manufacturing to foreign competitors, and the degree to which U.S. goods producers go multinational; new social and consumption patterns (e.g. greater consciousness of environmental impacts of consumption, greater use of public transportation) that redistribute demand between and within sectors; and the degree to which services such as information supply are integrated into a new, complex version of conventional goods-producing activity, making the distinction between the sectors irrelevant.

The movement of enterprise configuration away from conventional central locations toward the multiple locations of consumers is likely to be influenced in degree and speed rather than direction in the forecast period. Drivers are the speed at which goods producers are weaned from dependence on conventional fuel and waste disposal requirements; further dispersal of population centers, especially in the West and Sun Belt; possible environmental or resource constraints on conventional transport means;

and consumer choices between standardization and customization.

The adjustment of the 1990s is likely to have been especially problematic in determination of the U.S. role in the global economy. That adjustment should include major policy choices that would then play out through the forecast period. If policy makers continue to assume that the U.S. economy is fundamentally strong and that sharing trade and industry on an equal basis with foreign competitors will ultimately benefit all participants in an expanded world economy, policy may not have changed greatly by 2000. If it has not, scenarios for the forecast period would range from benign integration of the U.S. economy (including parts now labeled vital for national security) into an expanding world market divided into several major trading blocs, to exclusion of U.S. products from a world market unable to sustain the growth of its least competitive participants. The latter scenario would mean extended U.S. dependence on foreign suppliers for high-level (including military) products.

If, however, the issue of U.S. competitiveness gains political resonance in the 1990s adjustment period (whether or not actual U.S. economic competitiveness deteriorates), U.S. policy may abandon the optimistic view of free world trade by adopting trade barriers, restricting technology transfer and involvement of foreign firms in U.S. R&D and production operations, and/or targeting government support to critical industries. Selection drivers will be the nature and source of domestic political pressure, trade and investment practices by foreign competitors, and the degree to which U.S. economic indicators have rebounded by the beginning of the forecast period. Infrastructure changes (revamped educational/training programs, stronger investment incentives, permanent government/business steering committees) may also result.

The relation of the military and civilian economies will also have been rigorously tested by the year 2000. If the present separation of the two stands, military procurement will likely be much more expensive and military equipment more specialized. Drivers of this scenario are a long-term geopolitical situation allowing drastic reduction in volume and applicability of military equipment, combined with continued institutional resistance to reintegration of civilian and military production. On the other hand, reintegration would be triggered by procurement cost increases continuing through 2000, combined with geopolitical uncertainties continuing to require readiness and flexibility by U.S. forces--both factors strong enough to overwhelm institutional resistance. Even given the immediate onset of reintegration, however, results would only be visible starting in 2000, meaning that the forecast period would be a shakedown time for the new system.

Another major driver in this issue is U.S. budget commitments to the military. This in turn will continue to be influenced by public perceptions of threat and performance (the fall of the Berlin Wall reduced threat perception; Operation Desert Storm improved performance perception, hence willingness to spend) and by management of whatever national deficit exists in the forecast period.

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## **KEY JUDGMENTS**

### **UNITED STATES RESOURCES**

- The United States is in a position of strength in terms of food, water, medicine and associated-industry resources (for example, timber and fertilizer). There are adequate or friendly foreign supplies available.
- The United States is in a position of weakness in terms of energy resources, particularly oil. The forecast is for continuing reliance on fossil fuels for energy and dependence on imports for supplies. Fusion energy will not be operational before the year 2040. Safeguarding the next century's de facto strategic petroleum reserve, the Persian Gulf, is likely to require a U.S. military presence.
- The United States will face persistent dependence on foreign supplies for many strategic and critical materials, often concentrated in politically and socially unstable areas (the southern "High Africa" region and the Soviet Union). The United States will continue to stockpile these minerals and materials as insurance against supply cut-offs.
- The traditional patterns of resource exploitation, acquisition, and use will cause increasing concern for environmental consequences and changes will occur because of public awareness. These changes will foster new technologies and developments.
- The United States Army will be engaged in environmental missions and conservation activities at home and abroad in the future.

## THE UNITED STATES RESOURCE PICTURE IN 2015

### INTRODUCTION

No country has a greater vested interest in domestic and global availability, production and distribution of resources than the United States. With about 5 percent of the world's population and 7 percent of its land area, the United States consumes about 25 percent of the world's energy and finished products, and 13 percent of its raw nonfuel mineral production. Casual indifference to changes in the location, availability, production and distribution of vital resources puts U.S. welfare and security at considerable risk. Viewed in terms of domestic and world resource production and consumption, trends in some critical categories, mineral fuels and some metallic minerals, for example, have been unfavorable for years and a cause for serious concern.

Although it is still a country more generously endowed with natural wealth than most, the United States since the end of World War II has embarked upon a path of development that has been transforming it into an increasingly raw materials deficit country. By the 1970's the United States was consistently consuming more minerals than it produced. In 1988 the trade deficit in nonfuel minerals and metals amounted to \$22.3 billion, about 19 percent of the total trade deficit. Adding in charges for energy imports, in 1988 the bill for imported resources alone was \$64.1 billion or 54 percent of the total trade deficit. Meanwhile, the United States has drawn down its own geologic capital by depleting reserves of some critical and strategic materials.

Equally disconcerting from a security standpoint has been a trend driving some crucial industries (steel or, lately, semiconductor industries) for which U.S. raw material stocks are adequate to move a portion of production abroad or abandon the United States altogether. Iron ore reserves in the United States are adequate for hundreds of years of supply. Yet U.S. industry finds it increasingly difficult to produce steel at a competitive price, and manufacturing thus depends more and more upon Asian countries or Brazil for the enormous quantities of steel needed to build aircraft, automobiles, and other consumer durables.

Three of the most critical materials of an industrial society and its armed forces are: steel, aluminum, and refined petroleum; these materials will remain critical throughout the forecast period. In 1950 the United States produced 47 percent of the world's steel, 44 percent of the world's aluminum, and 52 percent of the world's refined petroleum [15]. In 1990, the shares had declined to 10 percent, 21 percent and 15 percent, respectively. If current trends continue, by 2015, the United States will account for just 4 percent, 9 percent, and 7 percent of these commodities so essential to U.S. economic prosperity and defense (see Fig. 1).

National and international security implications of import reliance for critical resources are far-reaching and profound. The recent war in the Persian Gulf illustrated U.S. resolve to sacrifice national treasure and American lives to protect one of the key sources of U.S. and Western prosperity. Petroleum and petroleum-derived products are indispensable to sustaining and enhancing the quality of life and

economic vitality of the United States and the developed world. In the forecast period, the assessment is that these products will continue to be the energy mainstay of the United States and the major Federal consumer, the U.S. Armed Forces.

Unfortunately, most estimates of domestic supply project significant declines in U.S. crude oil production, with concomitant reliance on foreign, primarily OPEC, oil stocks. Import reliance for natural gas is slated to double from 10 percent in 1989 to 20 percent in 2015. Between 1990 and 2015, coal will be the only exporting sector of the nation's import-dependent energy industry. As an intense user of transportation and hardware, the U.S. Army will continue to consume significant quantities of foreign oil, gas, and metals. Jet fuel consumption for defense purposes will continue to account for the bulk of petroleum consumption in the defense sector.

This study will examine the present and future of United States resource production, consumption and availability, emphasizing trends and their impact on the U.S. Army. The terrain has been covered before. The Club of Rome's The Limits to Growth and the U.S. government's Global 2000 are perhaps the two best known reports on resources of the United States and the world. The bulk of the information, however, came from more recent publications written by experts from both the private and public sectors.

The timing of the study could hardly be more fortuitous. This work began as hostilities in the Persian Gulf unfolded. In the midst of our research, the Department of Energy released the long-awaited National Energy Strategy. Because these two events have consequences for the future of U.S. resource production and consumption, they shall be discussed in subsequent sections. Resources are treated in categories such as food and water, mineral fuels, nonfuel minerals, within which are found strategic and critical materials. This study will also discuss briefly resources of the global commons: materials of the seas and atmosphere, the ozone layer, and space in near-earth orbit for satellites, for example.

Briefly, the resource outlook for the United States is either partly cloudy or partly sunny, depending upon one's perspective. In contrast to the points of view of many author/futurists in the field of resource research and analysis, there is neither an impending apocalypse nor El Dorado. The U.S. future with respect to resources is somewhere in between, more like California. The thesis is that the Golden State in particular and the United States in general are moving into a transition period marked by the challenge of shifting from a society of abundance and conspicuous consumption, which is increasingly unaffordable, to a society not necessarily of scarcity, but rather of moderation, perhaps toward the end of the forecast period even of national thrift.

The armed forces, accounting for fully 80 percent of the government's energy consumption, will not remain insulated from the primary features of this transition period.

Finally, this study considers some probable resource requirements of emerging technologies and alternative resources and the prospects that major changes will take place in the next 25 years to ameliorate some of the most challenging resource-related problems: acid rain, hazardous waste, and pollution; import dependence; a legacy of scarcity; and so forth.

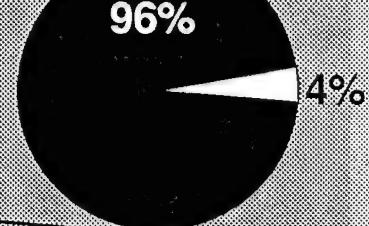
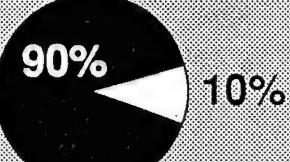
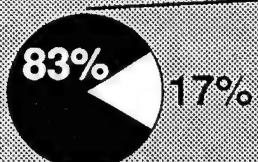
## U.S. and Rest-of-World Production of Steel, Aluminum Metal, and Petroleum

1975

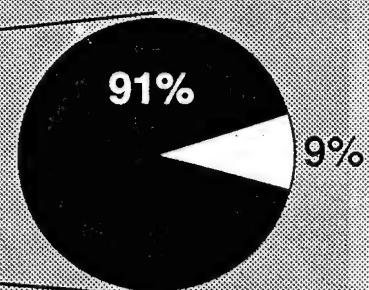
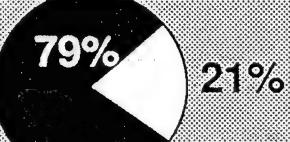
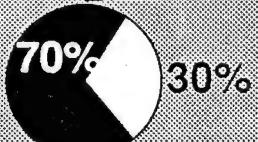
1990

2015 (est.)

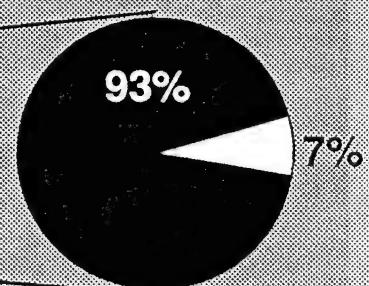
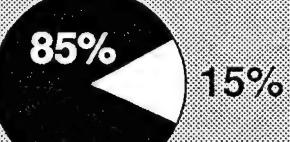
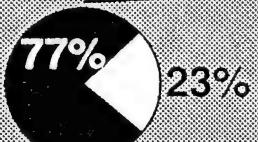
STEEL



ALUMINUM METAL



REFINED PETROLEUM



■ REST OF WORLD

□ UNITED STATES

Fig. 1

## **FOOD AND WATER**

With the exception of 1988, the year of a major drought, for the past 50 years the United States has produced much more food than it consumed in a given year. The assessment is that this beneficial trend will continue, barring any unforeseen catastrophe, such as northward migration of the country's breadbasket caused by persistent droughts from changes in the world's climate, that is, global warming, which is possible, but unlikely to occur by 2015. The on-going debate over global warming will have been settled one way or another long before 2015.

Overall more judicious use and conservation of adequate water resources is expected. In the west, however, costly major water redistribution projects (e.g., plan to pipe fresh water from Alaska to California) or the construction of large desalinization facilities are likely. Water management and conservation will be a key factor in sustaining the country's position as the world's principal farmer and grocer. It should maintain this position by virtue of U.S. agriculture's ability to produce more crops on reduced acreage, a trend that will continue.

With respect to key minerals, namely sulfur, potash and phosphate rock, supporting the world's largest and most productive agroindustry, the country is well-positioned to satisfy its needs from its own ample stocks in the case of sulfur and phosphate rock, or from a friendly foreign supplier, for example, Canada for potash, out to the year 2015.

As a result of these developments, the men and women of the U.S. armed forces in the year 2015 will be as well, or even better clothed and fed than those who have served before them.

## **ENERGY**

Plentiful and inexpensive sources of energy have played a key role in making the United States the 20th century's economic and military powerhouse. For the first half of the century, the country developed while producing more energy than it consumed. In 1950 the United States produced almost 34 quadrillion Btu of energy, while consuming 33 quads.<sup>1</sup> Since 1958, however, the United States has had to rely on foreign sources to satisfy its energy requirements in full. In 1989, it consumed 81 quads, or approximately 15 more quads than it produced. Twenty percent of U.S. energy in 1989 originated in foreign countries: natural gas in Canada and, most important, crude oil in various countries, primarily Saudi Arabia, Nigeria, Mexico, Canada, and Venezuela.

Without the desire or wherewithal to substitute other energy sources or to export commodities of equivalent value, the United States has gradually consumed its way into a position of vulnerability and

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<sup>1</sup>A "quad" (1 quadrillion British thermal units) is a standard unit used in comparing large amounts of energy. One quad is roughly equivalent to 1 year's worth of oil used at the rate of 500,000 barrels a day.

potential economic and national insecurity. The projection is that the trend drivers, high foreign oil imports and failure to identify, produce and sell equivalent value export commodities, will proceed apace.

With the exception of nuclear energy, which came on stream in 1957, for the past century the United States has relied on the burning of fossil fuels to satisfy most of its energy needs (85 percent in 1990). Throughout the century, coal, oil and gas have vied with each other as the predominant fuel in domestic production: coal in 1949-51 and again in 1982 and 1984-89; in the interim first crude oil and then natural gas dominated. In terms of consumption, however, oil has been the predominant energy source since 1950. Unfortunately, in the forecast period, the U.S. economy will become even more dependent upon fossil fuels than it was in 1990, with attendant negative economic and environmental consequences. Some portion of two of the three primary fossil fuels will have to be imported, much of it from politically and economically unstable areas.

### Oil

Because oil is and will remain in the forecast period the primary source of energy for the United States and the U.S. Army, it is appropriate that the study of individual mineral fuels begins here.

Although used since ancient times, oil as an industry began in 1859 when the first commercial well was drilled in western Pennsylvania. Over the years Americans have tended to view inexpensive and plentiful oil and its most important derivative, gasoline, as a kind of birthright. (In 1990 bottled water in some supermarkets was more expensive than gasoline.) Regrettably, each succeeding generation of consumers has been passing on to the next a greatly shrunken reservoir of domestic oil. Crude oil reserves stood at 44 billion barrels in 1970; 26.5 billion in 1990. While it is always difficult to predict reserves with any precision, if trends continue by 2015 U.S. proved reserves of crude oil may be down to about 14 billion barrels, the equivalent of about two years of national consumption.

In 1990 about 42 percent of the oil consumed in the United States was imported, 24 percent of which came from OPEC countries. By 2015, the United States is likely to be importing between 55 to 70 percent of its petroleum demand. Much of the imported oil will come from Middle Eastern countries, whose share of world reserves in the period is projected to increase substantially, as production and new discoveries slip elsewhere. Production in the Soviet Union, in 1990 the world's largest producer of crude oil, peaked in 1988 and has started what many analysts believe will be a long and steady decline. In February 1991, Pravda reported that the Soviet Union will become a net importer of oil as early as 1993 if trends continue. For the United States, the energy picture, in contrast to the food outlook, is distressing primarily because oil is and will remain the lifeblood of our highly mobile, automobile-based economy, society and culture. In 1990 about 35 percent of the world's registered vehicles were in operation on U.S. roads, most of which are asphalt, another petroleum-derived product. Much of the American way of life is dependent on the future availability and low price of a single commodity: oil and critical by-products. Petroleum feedstocks for the petrochemical industry, whose importance for defense purposes will increase as advanced materials and composites develop, are

projected to rise by 67 percent over the next 25 years.

**TABLE 1**  
**ESTIMATED PROVED RESERVES OF OIL (1970 and 1989)**

1970				1989	
(billion bbl.)					
Rank					Rank
1.	Saudi Arabia	138.0	169.9	Saudi Arabia	1.
2.	Kuwait	68.0	100.0	Iraq	2.
3.	Iran	55.0	92.8	Iran	3.
4.	USSR	55.0	92.2	Abu Dhabi	4.
5.	U.S.	44.0	91.9	Kuwait	5.
6.	Iraq	27.5	58.5	USSR	6.
7.	Abu Dhabi	18.0	58.0	Venezuela	7.
8.	Indonesia	18.0	54.1	Mexico	8.
9.	Venezuela	14.0	26.5	U.S.	9.
10.	Mexico	8.0	23.5	China	10.
Middle East Proved Oil Reserves (1989 percentage of world total): 58. [2]					

The strategic nature of oil was first highlighted in 1975 when the Strategic Petroleum Reserve (SPR) was created and filling of cavernous salt domes in the southwest began. Before President Bush authorized the release of stocks from the SPR in 1991, there were about 580 million barrels in the reserve; it is projected to increase to 750 million barrels by 2000 and ultimately hold up to 1 billion barrels (at current consumption rates, a scant two-month supply). In DOE's words, the SPR is a means "to effectively address shortrun oil market disruptions." [16]

Since it stopped relying on horsepower early in the 20th century, the U.S. Army has mostly used fossil fuels to power its land and air vehicles, warm its barracks, and generate electricity for its facilities. Until 1950, when the United States began to consume more oil than it produced, use of this fuel had marginal implications for national security. Despite intermittent murmuring on behalf of Texas independence, fuel supplies to the civilian and military sectors were safe and secure.

In the period under analysis, the U.S. Armed Forces and the U.S. Army will continue to rely for

the most part on forms of transportation powered by petroleum-derived products. The expectation is that the primary elements of future ground force weaponry, for example, tanks, armored personnel carriers, helicopters, and self-propelled artillery mounts, will probably be larger, heavier, faster, and more lethal than their predecessors, consuming greater inputs of fuel, ammunition and spare parts.

The analysis of resources is inseparable from the assessment of the future geopolitical situation. The Middle East will continue to be one of the world's most volatile and unpredictable regions, a region in which substantial U.S. military forces are likely to be based and engaged in hostilities periodically. Eventually the conservative autocratic regimes of Saudi Arabia, Kuwait, and the United Arab Emirates will be replaced with new leadership, who may or may not be compatible with American national interests and values.

In 1961 and 1991 British and American and allied forces were committed to the Persian Gulf to rescue Kuwait, in the first instance threatened by its neighbor Iraq and thirty years later invaded, occupied and ravaged by that country. Since 1950 there have been four major wars and numerous international crises in the Middle East and Southwest Asia, a region destined to function as the world's de facto strategic petroleum reserve. As the world's foremost economic and military power into the next century, the United States inevitably will be engaged in safeguarding the production and distribution of Middle East oil.

President Jimmy Carter characterized the energy crises of the 1970's as the "moral equivalent of war" and, despite the ridicule and scorn this statement engendered, he and his administration acted accordingly: the Department of Energy was set up in 1977; minimum fuel and electric efficiency requirements were mandated; and the Strategic Petroleum Reserve began to be filled.

In 1990 the energy crisis (in the form of Iraq's actual and threatened hostile takeover of two countries with the largest proved reserves of oil) was transformed from the moral equivalent of war into the real thing. Thousands of lives were sacrificed and billions of dollars and dinars were spent, first by Iraq seizing and then by the United States liberating Kuwait and protecting Saudi Arabia. Coincidentally, in 1991 during the Persian Gulf war the Department of Energy released the National Energy Strategy, designed to ensure an adequate supply of energy to meet United States future needs to the year 2015 and beyond. Initial analysis of the strategy indicates an emphasis on market forces and incentives, expansion of nuclear capacity, and modest increases in alternate fuels and renewable energy sources. In terms of potential, it fails to recognize and exploit fully two of the most readily available sources of energy: conservation and recycling or secondary use of resources.

In the forecast period, the assessment is that no segment of U.S. society will be able to consume energy at current rates without jeopardizing the country's economic and environmental health. Instead it is expected that the Federal government and the armed forces in particular will be called upon to undergo an environmental and ecological conversion in attitudes toward resource use and re-use.

#### Natural Gas

Even though the United States became a net importer of natural gas in 1958, the outlook for this fossil fuel is much brighter than for oil. In the forecast period, the United States will increase domestic production of natural gas, but not at a pace to keep up with projected consumption. Net imports are projected to double from 1.3 trillion cubic feet in 1990 (7 percent of consumption) to about 3 trillion cubic feet in 2015 (14 percent).

In the forecast period, most of U.S. imported gas will continue to come from Canada, a reliable source. Over the next 20 years, the price of natural gas is projected to rise to a point where imports from Mexico are expected to come on stream.

In terms of national security and compared to oil, natural gas is not considered a critical or strategic material. The U.S. armed forces are not major users of natural gas. It satisfied just 6.6 percent of defense energy requirements in 1990, down from 7.6 percent in 1980.

### Coal

Coal is the one fossil fuel of which the United States has an ample supply, taking into account every production/consumption scenario. In contrast to both oil and natural gas, in the forecast period domestic coal production will continue to outstrip consumption. Coal exports will increase significantly, although not nearly rapidly enough to compensate for mounting imports of oil and natural gas.

While still a cause for concern, the negative environmental consequences of coal mining and production and its consumption as a fuel in electricity generation are expected to be mitigated by production breakthroughs (clean coal technology) in the forecast period.

Overall, coal's share in primary energy consumption of fuels is projected to increase from 22 percent in 1990 to about 28 percent in 2015.

### Uranium

As a basic material for commercial nuclear power and plutonium for nuclear weapons, uranium is a doubly strategic material. Since 1982, the United States has been a net importer of uranium. In 1988, the United States continued to lead the world in the production of uranium, but imported ore accounted for 96 percent of total U.S. production. Although the United States has adequate domestic supplies of uranium to satisfy its requirements for both purposes in the forecast period, price advantages, as in the case of iron ore mining and processing, have led the industry to buy mined uranium abroad, primarily from Canada.

In the forecast period, the share of nuclear power for total electric generation is projected to decline from 20 percent in 1990 to about 14 percent in 2015. No new nuclear power plants have been ordered since the Three Mile Island accident derailed the program in 1978. Replacing older plants would require substantial inputs of generating capacity in the 2000-2020 timeframe, which appears unlikely owing to perceived safety and environmental impacts. The service lives of existing plants may be

extended, which should slow the rate of decline. If operating experience with fission plants abroad (for example, France and Spain) continues to be satisfactory, public concern over safety and the environment can be satisfied by safer plant design, and the waste disposal problem is solved, the United States may once again turn to nuclear fission as a power source. Nuclear power plants will have to be cost-effective, however, to be acceptable to industry.

Energy from nuclear fusion, cold or otherwise, so promising just a few months ago, according to the National Energy Strategy is now not expected to be commercially available until 2040.

### Oil Shale

Depending upon the price and availability of the primary fossil fuels examined above and technology developments, oil extracted from extensive shale deposits in the United States may come into production and use in the forecast period. This should be viewed as a wild card at best, but one that would substantially reduce import dependency and redirect trend drivers in the United States' favor.

### Renewable Energy Sources

The major sources of renewable energy are hydropower, solar thermal, geothermal, ocean thermal, photovoltaics, wind, and biofuels. Biofuels include such categories as energy from trash and organic waste, sewer gas, wood, methanol and ethanol.

In 1990 renewables accounted for about 7 percent of total energy consumed in the United States. By 2015 they are expected to increase to approximately 9 percent of total energy consumption. This figure could be considerably higher if incineration of municipal waste is selected as the optimal solution to the problem of shrinking landfill space and garbage disposal, or if states follow California's lead and legislate conversion of a portion of the fleet to methanol or ethanol fuels.

Various regions of the United States will accelerate the development of such energy sources, and California in particular will break new ground in the widespread application of solar thermal, geothermal, biofuel, wind and possibly ocean thermal sources of energy. Wholesale application of such power sources in other parts of the country will be constrained by both the forces of inertia and nature.

In concluding the analysis of the mineral fuels section, it is expected that in the forecast period the United States and its armed forces will continue to rely on fossil fuels to satisfy a diminishing, but still voracious appetite for energy. In 2015 power for land and air vehicles, for vessels, and for residential and commercial heat and air conditioning will come from traditional sources roughly in the following proportions:

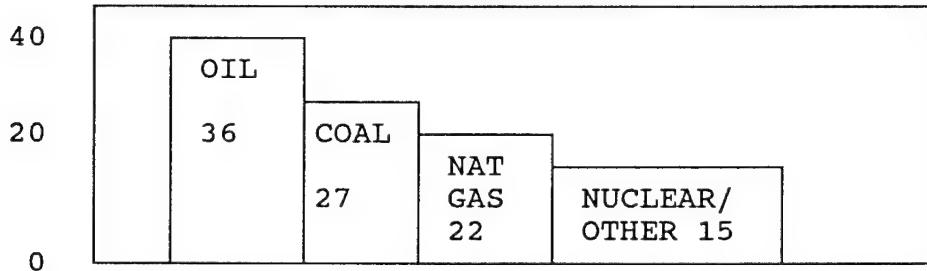


Figure 2. U.S. Energy Sources in 2015 (projected). [18]

## NONFUEL MINERALS

Energy crises of the 1970's and the recession in the early 1980's so battered the mining and metals industry that articles appeared announcing the "death of mining" in the United States. The rebound in the second half of the 1980's proved once again that death reports can be greatly exaggerated. Nevertheless, compared to its former dominance in mining and production of key minerals throughout the first half of the century, the U.S. metals industry has lost much of its luster. With one or two minor exceptions, molybdenum and magnesium for example, the industry's competitiveness has slipped in the global marketplace, and import reliance has climbed for many critical minerals and materials. As additional critical materials move up the import reliance scale and join the ranks of columbium, chromium and platinum, it is expected that this trend will continue in the forecast period.

There are more than one hundred commodities in the nonfuel minerals category. United States prospects vary considerably by subcategory. Overall the future does not look as bright as for food and water, nor as distressing as the prospects for mineral fuels. In a sense, the U.S. nonfuel commodities hopper is either half empty or half full.

Prospects are best for the group of nonmetallic minerals because estimated U.S. primary production into the next century is projected to equal or exceed forecast primary demand for more than half the commodities listed. Some of these minerals are boron, sulfur, and chlorine. The opposite trend is forecast for the group of metals and mineral-forming elements. If estimates are on target, U.S. primary production will equal demand for just 20 percent of the commodities listed and fall far short for such essential defense-related metals as aluminum, cadmium, gallium, gold, silver, nickel, tungsten, and vanadium. Thus, as one of the most metals-intensive sectors of the economy, the U.S. defense and associated high-technology industries will be confronted with a half empty or three quarters empty nonfuel commodities hopper.

The 1990 Statistical Abstract of the United States contains a table that lists 58 nonfuel minerals. Following a familiar pattern, for 42 of these commodities the United States consumes more than it produces. Despite the trend toward declining material intensity of use for most commodities in the United States, as recently as 1981 each American that year used more than 18,000 pounds of nonfuel

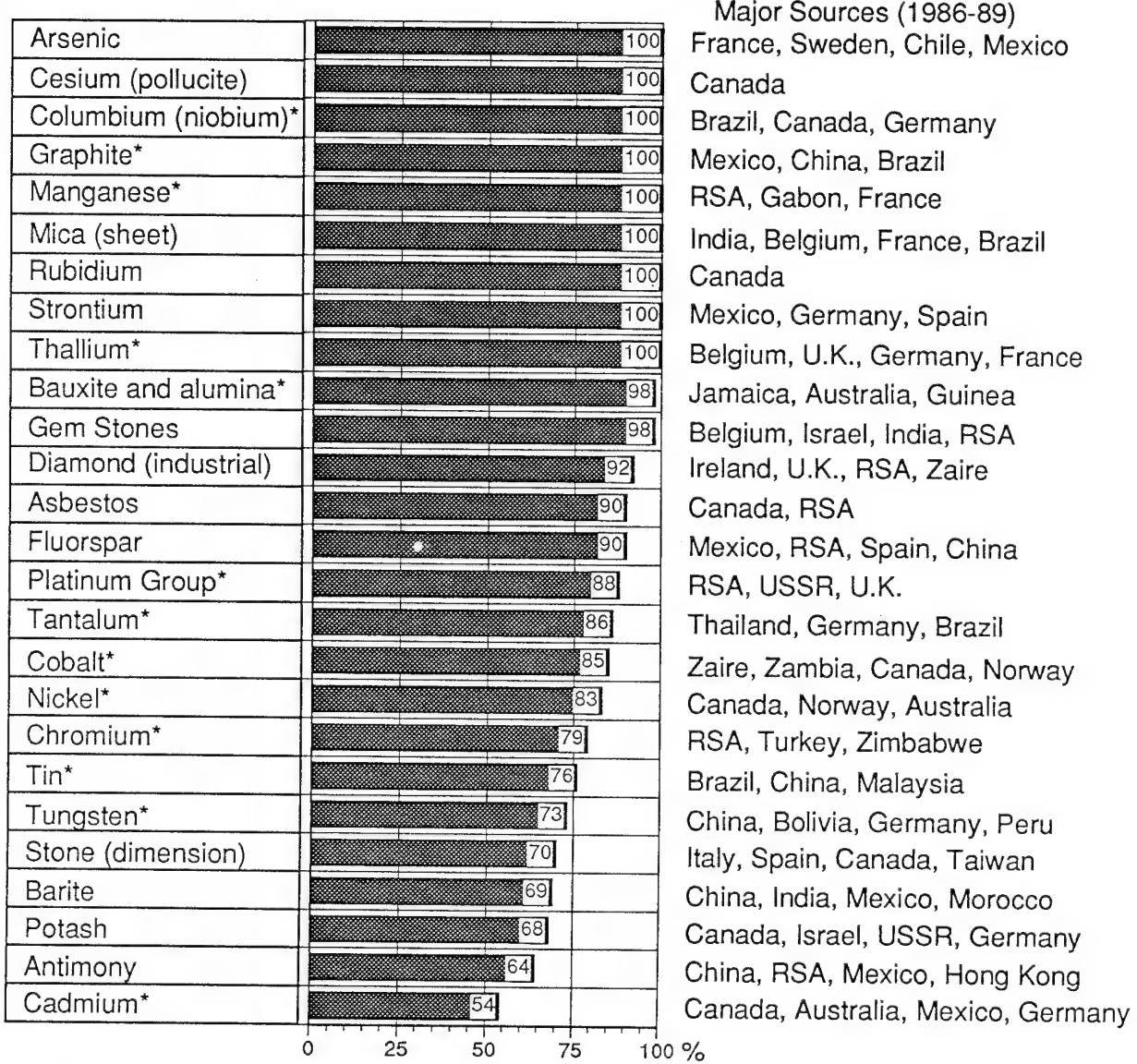
minerals. In 1991, owing to the war in the Persian Gulf, per capita indices for the armed forces will surely be much higher.

Although import reliance may vary considerably from year to year or be withheld to avoid disclosure, the trend for some key minerals is disquieting. For fourteen commodities, for example, import reliance ranges between 90-100 percent. These are arsenic, bauxite (from which aluminum is made), cesium, columbium, graphite, gem stones, manganese, mica, rubidium, strontium, thallium, diamond (industrial), asbestos, and fluorspar. In the next part of this study the future criticality and availability of some of these minerals and other key materials on the list of strategic materials will be considered (see Fig. 3).

## **STRATEGIC AND CRITICAL MATERIALS**

Prompted to respond to a war or national emergency, the United States has prudently established fuel and nonfuel mineral stockpiles to ensure adequate supplies in time of crisis. The Strategic Petroleum Reserve was created in response to a crisis in the supply of oil. Similarly, the United States by law maintains a stockpile of strategic and critical materials that are 1) not found or produced in the United States in sufficient quantity, and 2) required to supply military, industrial and essential civilian needs in a national defense emergency. As of January 1990 there were 94 commodities in the National Defense Stockpile (NDS), which was transferred in 1988 from the General Services Administration to the Department of Defense.

### U.S. Net Import Reliance for Minerals and Metals as a Percentage of Apparent Consumption in 1990



RSA—Republic of South Africa. Asterisk indicates material with major military applications.  
Data on some materials such as germanium and zircon are not disclosed.

**Fig. 3**

**TABLE 2.**  
**COMMODITIES IN THE STRATEGIC DEFENSE STOCKPILE**

ALUMINUM	FLUOROSPAR	QUININE
BAUXITE	GRAPHITE	RUBBER
ANTIMONY	IODINE	RUTILE
ASBESTOS	JEWEL BEARINGS	SAPPHIRE/RUBY
BERYLLIUM	LEAD	SILICON CARBIDE
BISMUTH	MANGANESE	SILVER
CADMIUM	MERCURY	TALC
CASTOR OIL	MICA	TANTALUM
CHROMITE	MOLYBDENUM	THORIUM NITRATE
COBALT	NICKEL	TIN
COLUMBIUM	OPIUM	TITANIUM SPONGE
COPPER	PLATINUM GROUP	TUNGSTEN
CORDAGE	PYRETHRUM	VANADIUM
DIAMOND	QUARTZ CRYSTALS	VEGETABLE TANNIN
FEATHERS AND DOWN	QUINIDINE	ZINC

**Note:** As of 1/1/90 there were 94 commodities in the SDS.  
Only 45 are listed because the remaining items are forms  
of these commodities. For example, there are seven items  
listed under chromite and chromium and nine under  
manganese. [14]

Aside from steel, aluminum and lead, there are at least 30 metals of critical importance to the U.S. military and the army. After all, weapons and materiel are largely manufactured of metal. In varying degrees these include metals from six major categories: base metals; steel industry metals; light metals; precious metals; platinum group metals; and electronic metals.

In the next part of this study prospects for production, consumption and availability of these metals to the year 2015 are studied. Especially critical materials will be treated individually; in some cases materials will be examined as a group.

Three of the most important minerals for national defense and associated high-technology industry are and should remain chromium, titanium, and cobalt.

### **Chromium**

The United States Army War College (USAWC) has devised an index to assess the relative vulnerability of the United States with respect to strategic materials. Heading it and most lists of strategic materials is chromium, with the highest USAWC Vulnerability Index rating (34). The United States stockpiles and will continue to stockpile substantial reserves of chromium for compelling reasons: since 1960, with the exception of a small amount in 1976, no chromite has been produced in the U.S.; U.S. foreign dependence ranges between 70 and 90 percent and imports come from four suppliers, the Republic of South Africa and Zimbabwe, Turkey, and Yugoslavia. Chromium has five major military uses (ammunition, armor plate, gun barrels, jet engines and stainless steel); and there are no fully satisfactory substitutes for most military applications of chromium.

The assessment is that since much of the world supply of chromite is concentrated in unstable or, until recently, traditionally hostile host countries, South Africa and the Soviet Union, stockpiling of this ferroalloy will continue to be a national priority in the forecast period.

### **Titanium**

The primary mineral sources for titanium are rutile and ilmenite. Sponge metal is made from rutile and both elements are included in the NDS.

In contrast to many minerals, titanium use in the U.S. economy and military is expected to grow at a relatively high rate in the forecast period. In the form of titanium dioxide, it will continue to be used as pigment for coatings, paints, ceramics, and fiberglass. Because of titanium's high strength to weight ratio, as a metal it will remain an important construction component in aerospace manufacturing and marine equipment. Consumption may increase substantially if a national commitment is undertaken to develop hypersonic air transport, expand the fleet of strategic bombers, or deploy one or more U.S. space stations.

Most of the world's rutile, which is 95 percent titanium dioxide, is produced in four countries: the Republic of South Africa, Australia, Sri Lanka, and Sierra Leone. Titanium slag is imported by the United States from Canada.

On the USAWC's index, titanium was assigned a value of 20, ranking in the middle of eleven minerals. The major supplier countries were listed as Canada and Australia, which mitigates the level of vulnerability, as these countries are deemed friendly reliable suppliers. The assessment is that these two countries will remain important allies in the forecast period.

### **Platinum Group Metals (PGM)**

Six metals make up the platinum group: platinum, palladium, rhodium, ruthenium, iridium, and osmium. Most of the world's supply of PGM comes from just two countries: South Africa and the Soviet

Union. In the forecast period, political uncertainty and potential revolutionary forces in those countries could cause disruptions in the supply of these and other critical materials concentrated there. After chromium, PGM with a score of 32 were second on the USAWC's vulnerability list.

PGM consumption could greatly exceed projections if, for example, Eastern Europe and the Soviet Union switch to unleaded gasoline (platinum for catalytic converters) or if the experimental technology of fuel cells is developed by 2015.

Because of their importance in electrical, electronic, and chemical processing applications, two PGM, rhodium and ruthenium were among four materials on the Secretary of Defense's list of recommended additions to the NDS in 1989.

### **Cobalt**

Cobalt, another stockpiled material, has broad application in high-technology industries such as telecommunications and aerospace, as well as significant military uses for jet engines and superalloys. For its primary cobalt consumption, the United States is 100 percent dependent on foreign sources, deriving about equal shares from one politically stable and reliable source, Canada, and two comparatively unstable sources, Zaire and Zambia.

Stocks of cobalt have been increased in response to political turmoil in southern Africa. In general, centrally planned economies and southern Africa produce about 75 percent of the world's supply of four critical minerals: chromium; platinum group; cobalt; and manganese. In fact South Africa has been called the "nonfuel minerals Saudi Arabia" (see Fig. 4). In the forecast period, the assessment is that other strategic material stocks may need to be augmented as instability and turmoil continue to buffet these areas. Assuming stability in Brazil, that country should continue to be an important source of critical materials (columbium, mica, and manganese, for example) to U.S. defense and high technology industries.

### **Manganese**

The United States was 100 percent dependent on foreign sources for its apparent consumption of 750,000 short tons in 1990. Five countries were the major suppliers of ore: Gabon, Brazil, Australia, Republic of South Africa, and France. There are no effective substitutes for manganese in its primary applications: steel production, dry cell batteries, plant fertilizers, and animal feed.

## **RESOURCES FOR EMERGING TECHNOLOGIES**

Under no plausible scenario will U.S. society or its armed forces in the forecast period dispense altogether with such traditionally critical resources as rubber, steel, lead, or aluminum. It is probable,

however, that in the next 25 years, in relative terms, these resources will decline in importance compared to resources required as basic building blocks in emerging technologies, specifically composites and advanced materials.

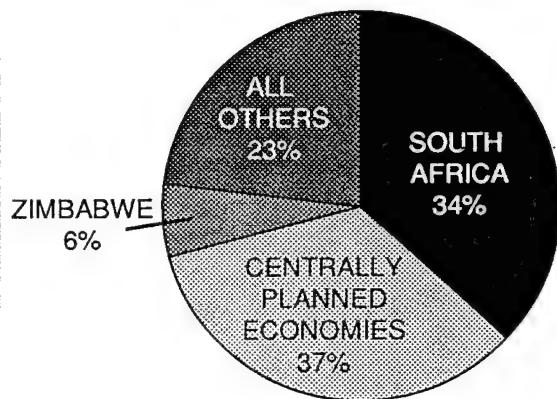
For example, as they have for centuries, it is expected that metals will be a primary agent of lethality in some 21st century weapons. And yet it is also envisioned that in the forecast period a situation in which non-metallic lethal, or even non-lethal, agents will be used to neutralize an enemy. These may be anesthetic or particle-beam "phaser" weapons.

Here again the U.S. outlook is cloudy. On the one hand, with its petrochemical industry, the United States has a powerful and well developed base to remain on the cutting edge of innovations in the field of polymers of almost any kind: ceramic, metallic or organic polymers. On the other hand, as an intense user of energy and petroleum feedstocks, the industry will accelerate the tempo of increasing dependence on foreign energy suppliers.

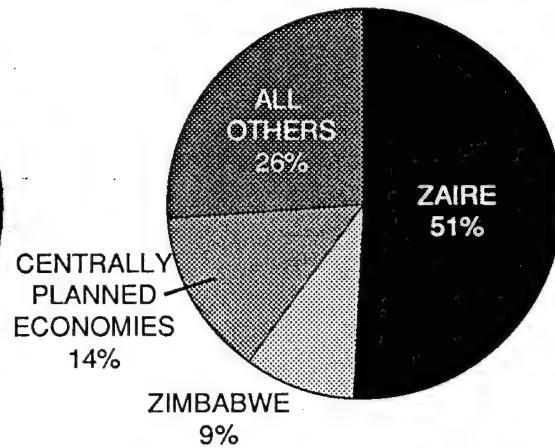
It is likely that high-technology hardware of the future will carry a higher percentage of material of the rare earth metals (thorium, yttrium, cerium) group. Fortunately, the United States in 1990 was a leading producer and processor of rare earths and was a major exporter and consumer of rare earth products. In relative terms, the U.S. position is stronger in this group in the forecast period.

# WORLD PRODUCTION FOR FOUR CRITICAL MINERALS 1983

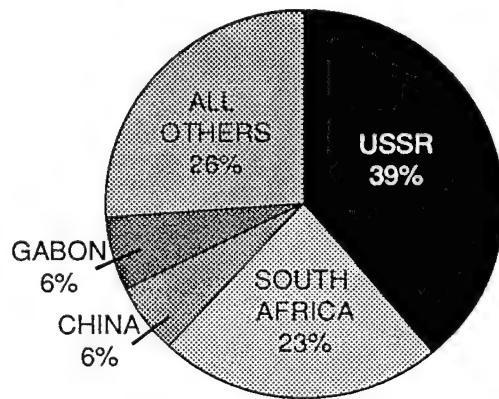
## CHROMIUM



## COBALT

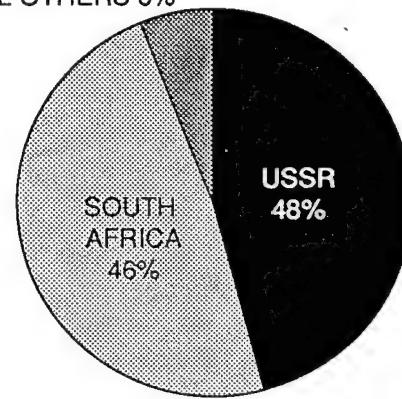


## MANGANESE



## PLATINUM GROUP

ALL OTHERS 6%



CENTRALLY PLANNED ECONOMIES AND SOUTHERN  
AFRICA PRODUCE ABOUT 75% OF THE WORLD'S  
SUPPLY OF FOUR CRITICAL MINERALS

Fig. 4

## ELECTRONIC METALS

When it comes to warfare, resources often determine not only where an army will fight (e.g., oil in the Persian Gulf), but also how it will fight (germanium in night vision devices and infrared target acquisition). If the Gulf War is any indication of warfare to come, and it is believed to be, in terms of future applications, the electronic group of metals, among which are silicon, cadmium, gallium, germanium, and tantalum, will largely determine how effectively the future U.S. Army wages war.

TABLE 3.  
METALS IN ELECTRONIC APPLICATIONS [7]

Copper*	Electrical wiring
Cobalt*	Magnetic data-storage devices
Columbium (Niobium)*	Superconducting computers and transmission lines (potential)
Platinum Group Metals*	Electrical contacts, multilayer capacitors, production crucibles
Gold and Silver*	Electroplating, wiring, capacitors
Silicon*	Semiconductors and photovoltaic cells
Cadmium and Mercury*	Batteries
Gallium	Gallium-arsenide electro-optical devices solar energy conversion devices
Germanium*	Infrared and fiber optics, infrared light transmission windows
Selenium	Photoreceptors in electrophotographic copiers
Tellurium	Infrared sensing materials (mercury cadmium-tellurium compounds)
Tantalum*	Capacitors
Indium	Solder, solar cells, optical coatings

\*indicates commodity in the Strategic Defense Stockpile

Consequently, the production, consumption, and availability of these minerals will be of keen interest to the United States and its armed forces. High-technology and defense industries will rely on these metals to make "smart" weapons "brilliant." In the next generation of computers, missiles, and helicopters, semiconductors, superconductors, and wafers manufactured of these materials will largely shape success or failure on the battlefield.

In this group, five of nine metals are in the NDS. These are silicon, cadmium, germanium, tantalum, and indium. Most estimates indicate that the U.S. Armed Forces and the U.S. Army will invest a greater proportion of budgetary outlays and boost their share of consumption of these metals as components in a myriad of electronics devices.

As one of the most abundant minerals in the earth's crust, silicon is not expected to pose a problem in terms of supply. In 1990 the U.S. relied on friendly reliable foreign sources for 30 percent of its apparent consumption. Gallium arsenide and germanium are acceptable substitutes for silicon in semiconductor and infrared applications. It should be noted that the reverse is not true, namely silicon is not an acceptable substitute for gallium arsenide-base integrated circuits in many defense-related applications. Although there is currently an oversupply of gallium in the world and it is not a stockpiled commodity, it may join the stockpile in the forecast period as applications increase.

The other four stockpiled metals in this group are cadmium, germanium, tantalum, and indium. As computer and electronics technology forge ahead in such fields as artificial intelligence, these metals will constitute a larger share in defense-essential components, and their proportion in the stockpile should increase accordingly.

On the subject of the National Defense Stockpile, in the forecast period, there will be some significant changes in both the size and composition of the NDS. Some stockpiled resources are based on World War II and Korean War requirements: talc, down and feathers, for example. The statutory requirement is to strive for the accumulation of a supply adequate to fight a three-year war. Modernizing the NDS may mean introducing a greater degree of flexibility in terms of duration, lengthening the requirements for some, while shortening them for others.

Overall, throughout the forecast period the NDS is expected to continue to be an essential means of forestalling disruptions in the supply of key minerals and materials.

#### **NONCONVENTIONAL RESOURCES: "Global Commons"**

The U.S. Armed Forces and Army will operate less and less in an insulated or isolated environment, both in terms of their role within U.S. society and internationally. That is to say, as the quality of key common resources deteriorates, specifically air and water quality or the ozone layer, more attention will be focused on the armed forces' impact on their surroundings, the environmental health of land and water resources near its bases or production facilities. But the armed forces may not only be part of the problem, they might also become part of the solution. This might involve both technical and human resources. In particular, defense assets, satellites or submersibles, might be used to identify environmental or energy-related problems (e.g., acid rain deposition, ozone depletion, build-up of greenhouse gases, undersea energy or mineral resources) and help to resolve or exploit them. It is possible that the U.S. military will become involved in such international issues as the allocation of space in near-earth orbit; leasing, rental or donation of military space technology for global environmental or energy projects.

It is likely that the armed forces will become more involved in waste management to a much greater extent than in the past. Budgeteers have tended to think of nuclear weapons' costs as relatively short-term expenses. In the process the problems and expense of safe storage and disposal of radioactive

waste were marginalized. In the forecast period the United States is likely to face staggering costs associated not only with the design and manufacture of new weapons, but also with the after effects of disposing of radioactive waste from weapons long retired from the arsenal.

In terms of resource conservation and recycling, it is expected that U.S. government and the armed forces of the future will no longer have license to consume resources in the vast quantities they have in the past. Government and defense expenditures for and consumption of energy and metals will be examined more closely. These developments will affect the individual soldier's training and service. In the forecast period, it is possible that the missions of the armed forces or a national service cadre will include performing environmental protection or resource management and conservation work on land or at sea. Then in addition to the BLUE and RED teams, there will be GREEN teams. In fact, it would not be surprising to see the U.S. Army before the year 2000 devoting as much time and effort to recycling and conservation of resources as it does in 1991 to physical fitness.

Should some critical land-based resources become scarce in the forecast period, the United States, alone or more likely as part of an international consortium, might spearhead an effort to exploit the enormous mineral riches of the seas, in particular mining nodules on the ocean floor. But exploration and exploitation would be conducted and managed with an unprecedented degree of responsibility and foresight, perhaps with U.S. Navy expertise and equipment.

As it enters the 21st century, and as other individual countries' roles diminish, the United States will likely assume greater responsibility not just for the physical security of large areas of the planet, but for the health of the global environment as well. This responsibility will be at least commensurate with the impact its economy, industry, and military has on the planet's common resources.

## SUMMARY OF PROJECTIONS AND IMPLICATIONS

Research and analysis of resource trends to 2015 leads to the conclusion that production, consumption, and availability of resources will continue to define to a great extent the position of the United States and its armed forces in the world. Fortunately, the outlook for such critical commodities as food, water and medicine and associated industries is relatively favorable. Nationally, there is no expectation of population-based developments bearing excessive pressure on these resources. Regionally, parts of the sunbelt may have to devise creative and expensive solutions to ensure adequate supplies of water and electricity in the forecast period.

The fuels picture is not nearly so reassuring. Trend drivers point to growing dependence on foreign suppliers for the U.S. fuel of choice: oil. New domestic finds for replenishment are not in the offing. Stability of the Middle East, the region with the largest proven reserves, is also unlikely to solidify in the forecast period. Hence U.S. forces will likely be deployed there on a regular, if not permanent basis, to prevent OECD supply disruptions and protect what will become in the coming decades the world's de facto strategic petroleum reserve.

Two recent and unexpected developments in the fuels area loom ominous. Should the countries of the now disbanded Warsaw Pact, with a population, area, and potential market larger than North America, be successful in their modernization efforts, the world's fuel and energy complex, and the global environment, will be subjected to enormous additional stress. Added to the pressures generated by similar efforts in the developing countries, this may trigger fierce competition among nations for access to a rapidly depleting oil supply.

A wild card in this scenario would be a situation in which a reformed, democratic Soviet Union or Russia, with the West's assistance, finds and exploits huge new petroleum deposits, thus reducing the importance of Middle Eastern oil reserves for the global economy. The surplus, probably from Siberia, would then be exported to the West and United States in return for high-technology imports.

Less likely is rapid progress toward alternate fuels or futuristic non-conventional power packs for transportation (hydrogen-powered vehicles, for example). Just a handful of corporations or corporate nations own and control most of the petroleum/automotive mega-industry. Revolutionary efforts on their part are not anticipated any time soon to reduce the developed world's dependence on oil and gasoline and the internal combustion engine.

The army is not immune to this dependency. Far from it. It would be a pleasant surprise to learn that fuel consumption was a major consideration in the design and development of the next generation tank or helicopter.

As a short-term national solution, stockpiling of petroleum will continue or even increase. Although leadership in this area is sorely needed, no forceful initiatives are expected to emerge from the White House or Congress equal to the challenge of reducing import dependency. Instead, communities at the state and local level will perforce expand conservation and recycling to cut costs for fuel and power and waste disposal. Federal agencies will then follow suit.

As a result of declining ore grades and aging U.S. production facilities, import dependency for many nonfuel minerals will proceed apace. Because many critical materials and minerals originate in potentially unstable countries, namely the "High Africa"<sup>2</sup> countries and the Soviet Union, the National Defense Stockpile and attendant legislation will continue to play a key role in guarding against disruptions that might emerge there. Less likely and less desirable would be troop deployments in southern Africa in support of friendly regimes and suppliers of critical resources.

Again, a substantial potential reserve of critical materials exists and can be exploited if recycling and ingenuity is applied to the metal-working and scrap metal industries. American products by design are often excessively entrophic, that is, they meld too many intermixed virgin commodities to make recycling practical or economical. In the forecast period, it may become more profitable to recover minerals from discarded materials rather than produce them from scratch.

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<sup>2</sup>The countries of "High Africa" are the mineral-rich southern African nations of Gabon, Zaire, Tanzania, Angola, Zambia, Malawi, Namibia, Botswana, Zimbabwe, the Republic of South Africa, and Mozambique. These countries contain over 40 major mineral districts.

Finally, traditional solutions are expected to be employed to resolve U.S. resource-associated problems in the forecast period: stockpiling of fuel and critical minerals; substitution of one mineral for another (silicon in optic fibers for copper cable); technological breakthroughs on the margins to extend gas mileage or replace one fuel with another; and when all else fails the planning and execution of operations such as DESERT STORM.

Unlikely but plausible is another approach, a Jules Verne scenario, in which truly revolutionary developments emerge to mitigate the impact of the major trends identified here with respect to resource problems. In this situation, by 2015 not only should American weapons be "smarter." American houses, cars and commercial buildings may only remotely resemble the dumb objects of today. Instead, an Edison-in-the-making will find a way to transform them into environmentally benign, thrifty consumers of energy. Some houses and buildings may actually export power to their neighbors.

With computers and electronics, the new infrastructure of the United States, when it is built, will interact with those it serves. The roadbeds may be giant solar collectors that impart power to vehicles running on or above the surface of the highway. Roads with a surplus of sunshine might transmit electricity to roads in shaded regions. Ways might be found to harness and store for later use the power of atmospheric electrical charges. And the oceans covering most of the globe ultimately promise to yield a wealth of minerals, energy and fresh water.

At the end of all the research and analysis there is one certainty. After studying more than 100 different minerals and resources, a single resource can be identified as the most critical, most strategic material for the United States and the U.S. Army in the coming decades. More precious than gold, keener than a diamond, with no known substitute, the human brain, roughly three pounds of bundled fibers per issue, holds within it most if not all the answers to the questions this study has raised. Happily for the United States, no shortages of this resource are anticipated in the forecast period. In 2015 the U.S. will have about 900 million pounds of grey matter in circulation. Just how resourcefully and creatively the nation will use this critical material is the subject of the next study.

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## KEY JUDGMENTS AMERICAN EDUCATION

- Substantial reform of the education system is required to remain competitive. Reports of graduating functional illiterates and stagnating achievement levels have delivered a grim message to the public.
- Public education will become a reflection of the increasing ethnic minority population. These minorities are traditionally considered at-risk: at greater risk of failing to achieve, of dropping out, of not being productive members of the labor force.
- Demands on public education will continue to change, reflecting changes in American family structure. Social services, such as health care, family planning, day care, and drug counseling, once the domain of families, will increasingly become a part of the educational environment.
- The federal government will contribute enthusiasm and vocal support, but the financial base will continue to rest with state and local governments.
- Reforms in education are influenced by demographics, multiculturalism, contending bureaucracies, and new technologies. Reform proposals will include choice, decentralization of schools, national curriculum, national standards and tests, and performance-based assessments. Domestic political pressures, contending interest groups, and public opinion will challenge the reforms.
- Corporate investment and apprenticeship programs will be seen in isolated areas. The cost of major reform will be too significant for the business world to bear.
- Major changes in public education will not occur until the American public believes its future to be seriously threatened. Until that time, the hard political decisions will not be made.
- The Army will not have a manpower pool equipped to be better cognitive thinkers and problem-solvers, hence more intensive training procedures will need to be implemented.

## AMERICAN EDUCATION IN 2015

### OVERVIEW

"Education has consequences for the quality and equality of political and economic life that extend far beyond the individual student or the student's family." [1]

Malaise has settled into the education system of the United States. United States students measure poorly in international comparisons of educational achievement. One of the consequences is that the United States has lost its competitiveness in the international economic arena. Changes in education are initiated in fits and starts, are incremental and slow, and by 2015, the necessary overhaul of the system will likely remain incomplete. It will take longer to see results. Reforms are challenged by domestic political pressures, contending interest groups, public opinion, and legal considerations.

One of the problems facing education reform is the size of the education bureaucracy. In fact, various bureaucracies--state and national legislatures, governors, school boards, chief state school officers, higher educational institutions, teachers' unions, and foundations, influence education reforms either by advocating and promoting (some of) them, and/or impeding the changes. As state and local shares of school budgets have increased over the last few decades, so too have the number of state and local regulations. Federal regulations also have proliferated--most relating to increased federal grant programs.

Demographic factors are a driver of change in education policy and programs. As minority populations increase to approximately two-thirds of public school enrollment by 2015, the politics of race versus multiculturalism will also become an issue in the debate over systemic reforms. According to its advocates, multicultural education (multiculturalism, which its critics distinguish from cultural pluralism) seeks to enrich students' knowledge of history and an appreciation of American diversity, with an understanding that we are one nation with a common set of political and moral values. The current focus of the multicultural debate challenges the Eurocentric focus of education (centered on the United States and the West, in terms of the social history of America), and seeks to incorporate Afrocentrism, a "particularistic" approach. As American society becomes more diverse, a more "pluralistic" approach will need to be considered.

According to Pallas, Natriello, and McDill, the single most important factor in the school-age population of the future is the expected increase in both the number and proportion of traditionally disadvantaged young people. They identify five key indicators associated with educationally disadvantaged youth which correlate with poor performance in school: minority racial/ethnic group identity, living in a poverty household, living in a single-parent family, having a poorly educated mother (usually the head of the household), and having a non-English language background.

Children from disadvantaged backgrounds leave formal schooling with fewer cognitive skills and

lower levels of cultural literacy than their more prosperous counterparts. Noncollege youth have been consistently overlooked and undertrained. Some of these youth enter military service, which can provide job training, experience, and time to mature.

Although a uniform and accurate counting system for student dropouts does not exist, the fact remains that disadvantaged students are at a greater risk of dropping out. Minority students are more likely to be behind their modal grade (and subsequently drop out) than white students. In many large cities, where public education is dominated by minority populations, disadvantaged youth account for a large proportion of the dropout rate. Students in certain parts of the country are also at a greater risk of dropping out. The most common reason for dropping out is poor academic performance.

Education reform in the late 1980s was directed at: designing education for the 21st century, organizing a system of lifelong learning, enriching and diversifying elementary and secondary education, improving and diversifying higher education, improving the quality of teachers, adapting to internationalization and the information age, and conducting a review of educational administration and finance. Education reforms address different concerns in rural areas. Many rural districts are disadvantaged because they have fewer resources--as a result of lower tax bases and a greater difficulty in recruiting and retraining teachers. Rural schools often lack a large enough student base to support diverse program offerings--including a limited ability to provide vocational programs. Where instructional staff is lacking, technology will fill in the gaps. Rural schoolchildren will also be expected to adhere to a national curriculum, take national examinations, and meet national standards. Multiculturalism will not be an issue.

New technologies will render many careers obsolete by 2015. Our high schools turn out semiliterate young adults ill-equipped to deal with the technological world, frustrating the needs of the work force for better-prepared employees. The continuing shift from manufacturing to service industries will result in many jobs demanding high levels of technical knowledge and skill, and most will require well-developed social skills. The jobs that employ the greatest number of people will not require more than a high school education, and often less. Three types of skills traditionally not required of lower-level jobs are becoming more critical: a higher level of cognition and problem-solving; flexibility--knowing how to perform a variety of tasks; and teamwork--including the capacity to resolve conflicts. Business and military leaders complain that they must spend millions of dollars on remedial education and training programs in such basic skills as reading, writing, spelling, and computations. In the future, the question of a course of study may be tied to a minimum outcome level, not a fixed number of years, and high school graduates will need more than good performance records on standardized tests.

Most students realize few benefits from working hard while in school since the labor market in the United States, unlike other industrialized countries, does not reward effort and achievement in high school. (This may have some effect on the decline in test scores since students have little incentive to do well.) High school graduates in Canada, Japan, and Europe compete for attractive jobs on the basis of knowledge and skills gained in high school. Achievement tests are closely tied to the curriculum. Performance on these tests is the primary determinant of university admission, and to a particular field

of study. Job applications at all levels require information about examination grades. These national examinations are yardsticks by which achievement is measured in terms relative to everyone else's in the nation. Mathematics and science achievement are regarded as especially important. In Germany, high school grades are the major determinant of who gets the most preferred apprenticeships.

Parents in the United States hold their children and schools to a lower standard than do Japanese, Taiwanese, and European parents. Students in the United States spend less time receiving instruction, studying, and doing homework, and more time watching television, than do students in other industrialized nations.

The distinction between **national** and **federal** will continue. The move towards a national curriculum, national performance standards and assessments, national achievements, and national teacher certification will be distinguished from federal intervention. The major responsibility of the federal government will be in legislative and judicial matters and as a cheerleader and bully pulpit in influencing the conduct of education. National goals (a federal mandate) will continue to be established in order to keep the United States from falling further behind in the international arena. The federal government will target pilot programs, initiatives, and assistance for handicapped, disadvantaged, and at-risk youth. State and local funding will continue to predominate in operations (program).

David T. Kearns, CEO of Xerox (and Deputy Secretary of Education designate), has called for the complete restructuring of public education in the United States. Kearns believes that since education interests have failed to improve the school system, it is up to the business community, which understands competition and market discipline, to set the new agenda.

Kearns advocates improving schools by hiring better teachers and paying them more, strengthening the curriculum, improving tests and measures, and expecting more of students. It is imperative that school districts confront the realities of the twenty-first century--and rid themselves of nineteenth-century organizational bureaucracies--by emulating successful companies that are decentralized, relying on the know-how and professionalism of workers close to the problem, being flexible, and spending heavily on employee education, training, and investment in research.

As a result of The National Commission on Excellence in Education report, A Nation at Risk: The Imperative for Educational Reform (1983), there have been some modest advances on the education front. The minimum requirements for graduation from high school have been raised in almost all states. The states that lengthened the school day have witnessed an increase in test scores--a questionable criterion of success when 25 percent of high school graduates remain functionally illiterate. Mathematics and science curricula have received more attention and have enrolled more students. These reforms raise new areas of concern--for example, how do additional requirements serve the needs of disadvantaged students?

Over the last few decades, federal spending on education has declined (taking into account inflation), while state and local expenditures have increased. The primary provider of education revenues is local government. Improvements in the education system cost money: a longer school day/year, increased graduation requirements, significantly reduced class size (a primary influence on achievement),

a better evaluation system, more staff development, and technological assistance.

Spending more money, however, is not enough; the public education system must be overhauled. In particular, the federal government must be in the vanguard of funding and developing national assessments that are performance-based. In fiscal 1990, only a small proportion of the education budget (approximately \$100 million of about \$24 billion) was spent on promoting accountability for school performance. Currently, the federal government does not make its support contingent on performance or state and local innovations; choice aims to make schools accountable.

## THE SCHOOL OF THE FUTURE

### Choice

In the late 1980s, the issue of school choice came into focus. Supported by the presidency and Department of Education, choice involves legal, political, economic, and educational issues. Choice is a market-oriented reform--parents and students can choose which educational "market" they want to attend--that relies on school-based management (decentralization) to hold schools accountable for their own performance. School choice issues include: public or private schools, vouchers or tuition tax credits, interdistrict and intradistrict choice, magnet schools, post-secondary options, second-chance programs, and home schooling.

Choice advocates say that market control will reduce the constraining education bureaucracy (already cited as a burden to improved performance), make the relationship between schools and democratic authorities much less prone to excessive regulation and inadequate accountability, and result in closer and more cooperative relationships among schools, students, and parents. All these developments will promote (and hopefully raise) student achievement. A school either improves or goes out of business. As a method of improving public education--via competition for students and the empowerment of parents by involving them more in their children's education--choice has received political and popular support, academic and media approval.

Public school choice is an issue for state legislatures, and by 1990, was on the legislative agenda of half the states. Advocates say that public school choice does not require large-scale federal appropriations. According to Lorraine McDonnell, however, magnet schools are 10 to 12 percent more expensive to run than traditional schools; some specialty schools are even more costly to operate. And, funding for transportation may be required at the state level.

Choice advocates view public school choice as an equalizer--a means to foster racial integration--though critics fear resegregation. Disadvantaged minorities generally do not transfer from inner city to suburban schools. Some choice plans have judicial restrictions--choice is not an option where it tends to segregate and discriminate against populations.

Advocates also argue that different children perform better in different learning environments--and

that one should be able to choose that which best meet one's needs. Often, however, choice does not involve specific educational programs or achievement records, but rather services--whether a school offers day care or a strong athletic program. Choice is also more likely to be exercised in heavily populated areas with greater access to public transportation.

Choice advocates Kearns and Doyle propose that all public school districts with more than 2,500 students reorganize into voluntary year-round magnet systems that would offer open enrollment around academic or vocational specialties. Year-round schools will allow for maximum coordination between work and school, and strengthen the ties between the business and education communities. Participating schools will have incentives, entrepreneurship, unit-level accountability, and consumer responsiveness reminiscent of the private sector, but with universal access, minimum outcome standards, performance tracking, and the fiscal arrangements of a lightly regulated public sector enterprise. The state would prescribe minimum standards and ensure that all students are placed.

Former Department of Education Assistant Secretary for Research and Improvement, Chester Finn, has said that under the system of choice, the distinction between "public" and "private" will blur. Voucher plans, under which states allow the use of tax revenues to pay for education in public, private, and parochial schools will facilitate this "blurring". This will be a contentious political issue with regard to the constitutionality of the separation of church and state. It is also unlikely that lower income families will be able to afford private schools even with vouchers.

Critics are also concerned about the quality of information and whether adequate information about programs, personnel, and performance would be forthcoming so that parents could make informed choices about schools (well-educated and middle and upper class parents are more likely to make better choices than the economically disadvantaged). Critics also fear that some education markets might support too few competitors to realize market advantages. Further, schools might not select economically disadvantaged students--they cost more to educate and financial resources are not necessarily equal.

If choice is not exercised to a significant degree in states where it is an option, it is unlikely that choice will continue to be pursued at the federal level. By 2015, choice advocacy will be limited by a (likely) lack of the exercise of choice and its added costs. If, however, a significant level of choice is exercised, and, as a result, achievement levels raised and better societal integration evidenced as a byproduct of that option, it is likely that choice will become a nationally legislated norm. Better school accountability and performance as a byproduct of choice, resulting in a more functionally literate and "smarter" student body, will have a positive impact. Success in raising achievement levels as a result of public school choice may likely influence the adoption of choice plans that apply to private schools. Decentralization may be a lasting result of reform efforts even if choice does not succeed.

### **Decentralization**

In the 1960s, the education system was centralized--run top-down from school superintendents, to principals, to teachers. In the 1990s, education reformers advocated decentralization.

Decentralization and deregulation, that is, school-based management, is both an integral part of public school choice plans and a separate reform issue.

Kearns envisions central school district offices as service centers, not command posts, and school principals as the most important and most vital link in the "education chain of cause and effect." The central administration receives funds--to be spent by the principal and staff. The principal is the CEO.

Under this scheme, schools recruit, retain, and remove staff. Schools are also responsible for resource allocation, scheduling, and instructional organization. By disbanding the mid-level offices between the central school district office and the school itself where functions are often duplicated, decentralization puts resources back into the schools where staff decisions, not a system-wide formula, directs spending. Teachers and principals would decide on the amount of overhead (services offered by central offices but purchased on an as-needed basis by the schools)--in areas such as textbook acquisition, library services, and counseling. Along with eliminating bureaucratic intermediaries, decentralization envisions introducing modern management concepts, thereby promoting accountability and, in turn, improvement. Decentralization will proliferate by the turn of the century.

If, as intended, decentralization succeeds either as a cost-saving measure and/or impetus for improvement, (some parts of) the educational bureaucracy will be streamlined and school-based management will become institutionalized. If savings are inconsequential and educational achievement fails to improve, centralization will resume.

### Curriculum

The back-to-the-basics movement will be altered. The label applied to the "3Rs" approach is too limiting. A national curriculum framework with regional variations, driven by more rigid mathematics and science requirements (and more courses in these subjects), and the need to instill higher-order thinking skills (in order to raise international competitiveness), will lead to more rigid, mandated high school graduation requirements, and will be instituted by 2015. (Japan and most European nations have national curricula, See Appendix A.) Many states already have legislated stricter academic requirements (particularly in mathematics and science) for high school graduation, resulting in changes in curriculum guidelines. Lack of improvement in international achievement comparisons will accelerate the move towards a national curriculum.

The extent of curriculum specificity (which can be detailed by outcomes--not weekly guidelines) and the quality and variety of curriculum materials are also parts of curriculum reform. Other curriculum changes will address access to information, thinking clearly, communicating effectively, understanding the environment, man and society, the rights and responsibilities of people in a global society, and personal competence.

Interdisciplinary courses, to include computers and other information technologies, will become an integral part of secondary education.

The curriculum reform debate also drives other issues--the role of national examinations (and the

need to first devise adequate assessments and standards), the quality and effectiveness of teacher preparation, pressure for cultural literacy (multiculturalism), and school restructuring (school-based management and choice). Testing and accountability, according to Linda M. McNeil, produce a "de facto national curriculum that is driven by supposedly scientific and neutral objectives conducive to computerized scoring--a curriculum that is not subject to political scrutiny."<sup>[38]</sup> Cultural literacy debates are largely academic. School restructuring implies that if current school structures inhibit or distort curriculum, curriculum can be improved by reshaping the structures.

Kearns and Doyle suggest that a core curriculum, at least through age 16 (grade 10), but preferably until age 18 (grade 12), be adopted, and that promotion to a higher grade not be granted without certification of performance. Certification can be handled through examination, in the same way students take advanced placement examinations in high school to gain college credit. Kearns and Doyle also advocate the "flexible term equivalent"--performance organized around accomplishment of the curriculum, not units of time. This would also result in a move away from machine scorable tests (the SAT and ACT), which are advantageous to the middle class and disadvantageous (that is discriminatory) to at-risk and minority students. These tests also neglect the oral and written form.

A national curriculum core, even one with regional variations, will present advantaged and disadvantaged students with the same framework. Such a curriculum and its byproducts (for example, teachers and students held to common sets of expectations, improved teacher training and materials development) made available to all groups on an equal basis, without requiring localities to make vast investments of money and time, might help to minimize the gaps between the various education constituencies and promote educational equity. (However, objections to these measures are the same as those used to point out the discriminatory nature of national tests.) The previous trend towards basic skills education, as the best way to pursue educational equity, has helped to narrow the achievement gap between black and low income children (versus white and higher income youth), but has produced students lacking a rich knowledge base and higher-order skills.

### **National Tests**

National tests--standards, that is performance-based assessments--are critical to education reform. Driven by the national curriculum framework and stricter high school graduation requirements, they will be developed gradually, and may be in place by 2015. Unless these tests are developed as performance-based assessments, in tandem with systemic educational reform, they will neither measure for accountability, nor have teachers do anything but "teach for the test." Consequently, a movement to change the nature of assessments--that is, to measure higher-order skills, has developed. These tests will not be today's computerized multiple choice questions, which stress lower-level skills heavily dependent on memorization, teaching to the test, and discriminate against minority populations.

National assessments should be consistent with the reorientation of learning skills and accountability goals, measure competency, be based on proficiency, have well-designed remedial

programs (to assist those in reaching national standards), and be capable of monitoring instruction and learning with the periodic testing of general achievement and specific skills. They should measure not only qualitative standards in mathematics, science, and English language skills, but also proficiency in problem-solving, reasoning, and creativity. Those who believe that a well-conceived national test can be an important lever for upgrading what is taught and learned in school see the lack of such a test in the United States as a source of frustration. If minority students do poorly on this national test, however, there may be considerable political pressure to drop it as well.

The President's Advisory Committee on Education is considering the appropriateness and feasibility of a national test administered to all students at two or three grade levels. (Most industrialized countries have a national curriculum and national examinations that are given to almost all students at some time). One version of the test would have it normed to international standards—poor performance of U.S. students vis-a-vis their international counterparts would trigger greater public interest in education reforms. Another proposal would base test content on explicated syllabi and make the test an important influence in students' lives by making results available to college admissions officers, or future employers. Increased motivation and better behavior may be a byproduct, if the sharing of results makes students more serious about their studies. Alternatively it could lead to even more damaging discrimination against minority students, stigmatizing them, and shutting them out of college or the workplace.

If national examinations are tied into an accountability system, they might also provide a means for evaluating the effectiveness of particular schools—and for rewarding them. This would motivate teachers and administrators to find the best ways to teach the national curriculum. It might also support the choice argument—schools that perform well on the tests will perform well in the "market." National tests must show achievement gaps and push the federal government to provide additional resources to the schools most needing help to reach national standards. However, the decline in national test scores may also lead to a diminishing focus on those who perform well. Some critics cite the establishment of a national test as leading to the imposition of a national curriculum without discussion. This may increase lobbying against both standards and curriculum and delay reform efforts. Others point out that although a national curriculum core is reasonable and appropriate, standardized tests measure stability, not variability (achievement levels of large groups of students for whom there are common expectations), and discriminate against special needs populations.

Changes in the National Assessment of Educational Progress (NAEP), which provides periodic assessments of students in a number of subjects, using national samples of students from three age/grade levels, have influenced the trend towards developing a national curriculum. These data are the only consistent national achievement measurement in the United States. Until 1990, NAEP reported national grades only. In 1991, for the first time, the NAEP will report findings on a state-by-state basis on an eighth grade mathematics assessment. State participation is voluntary, however. This experiment, permitted by a new federal law, will probably expand in 1992, when fourth and eighth grade mathematics will be assessed—again, in as many states as wish to participate. Assessment results could increase

pressure on state policymakers to bring state curricula in line with NAEP frameworks. NAEP comparisons reflect performance of a much more representative sample of state's students than do SAT and ACT scores, which measure college bound students, are administered late in secondary school, and are insensitive to the school curriculum.

### **Achievement Levels**

The level of U.S. students in achievement tests of international comparison (the United States is low relative to other industrialized nations) may show some improvement by 2015. Achievement levels have shown little gain in the past decade, and at the current rate of achievement, the United States has much to do in order to catch up. Again, a fundamental overhaul of the education system is needed prior to realizing positive results and large gains in achievement scores.

John H. Bishop, of the Department of Personnel and Human Resource Studies, New York State School of Industrial and Labor Relations, Cornell University, posits that the large and historically unprecedented test score decline between 1967 and 1980 negatively affected the quality of the work force and the GNP. This decline was across the board--for whites and minorities, public and private schools. Declines were greater for higher-level skills (inference and problem solving) than for the basic skills (arithmetic computation). There was no visible decline in the first few years of elementary school, although the advantage of being better prepared for first grade than were earlier generations lasted only through the third grade. Since a decline affects a work force over a period of some 50 years, these shortfalls are enduring.

Bishop points out that recent efforts to improve the quality and rigor of the curriculum have led to rising test scores. However, the general intellectual achievement level (GIA) of high school seniors has remained substantially below the level that would have been reached if the rate of gain of academic achievement of the 1940s through the early 1960s had continued, rather than reversed beginning in 1967. Bishop sees a parallel decline in academic achievement in the applicants to graduate and professional schools between 1966 and 1980, as well as a similar recent rebound in test scores. Bishop notes that even if current efforts to improve education succeed, the earlier period of low test scores will continue to depress productivity well into the 21st century because of the growth of the labor quality shortfall. He suggests that the only way to prevent these forecasts from coming to fruition is to change the relationship between the GIA at age 17 and the GIA as an adult. This will be done by luring massive numbers of adults back into school, expanding educational offerings on television, and/or inducing employers to provide general education to long-term employees.

### **National Teacher Certification**

National teacher certification will come about more slowly than the movement towards a national curriculum framework and national assessments. A natural offshoot of these developments, teacher

certification (licensing) should test both for basic skills competency and area expertise.

A national curriculum framework would help to structure a common knowledge base for teachers. However, a vast investment in professional teacher development is needed if the benefits of a national curriculum are to be realized. The necessity of bringing pre-service education in line with the curriculum requires great changes in the curricula of teacher-training institutions and licensing requirements. Licensing examinations and inservice programs probably will be based on improving understanding of and ability to teach national curriculum content.

The acknowledged teacher shortages in specific subject areas, however, will mitigate requirements where area expertise overrides the need for certification. "Alternate certification," a practice that relies on a person's demonstrated knowledge, skill, character, and willingness to impart some of that knowledge to children, allows adults to attain provisional status in the education profession. It is likely that "alternate certification" will increase and co-exist with demands for national teacher certification standards, enlarging the pool of prospective teachers, particularly where there are shortages, (both for specific disciplines and in certain geographic areas), as well as equal opportunity considerations. Some reform proponents even advocate that in some subject areas instruction not be limited to teachers and that professionals be used instead.

Teaching ability can be learned--by apprenticeship to a master teacher. Kearns and Doyle advocate eliminating the degree in education and substituting it with a bachelors degree in a subject matter, followed by a fifth year internship in a school building, supervised by a master teacher.

Kearns and Doyle believe new licensing standards should be flexible and diverse, based in large part on performance standards, and measured by knowledge of subject matter (although knowledge of subject does not guarantee an effective teacher). They also believe licensing is a state responsibility.

Teachers' unions and demographic changes will impede national certification on the basis of equal opportunity and human resource issues. Some schools and/or states may move towards intern and master teacher certification programs. Certification is a contentious issue with teachers' unions. Merit pay issues will continue to be both contentious and an issue of fiscal concern.

As computers and new technologies transform the classroom, and computers are combined with team-teaching and collaborative learning, teachers' jobs will change. Teachers will still have a critical role in providing effective learning situations but will need increased training and institutional support to successfully teach with technology.

Teacher retention will be based on job performance. According to the concept of school-based management, principals will be responsible for firing ineffective teachers. How, and under whose responsibility they will or will not be retrained is another issue, not addressed here.

### **Multiculturalism**

Multiculturalism versus the politics of race, a controversial political issue, will be influenced by the changing demographic picture. Although multiculturalism pits the traditionally Eurocentric approach

to history and society against the Afro-American ("particularistic") experience, demographics will also have an impact on this issue. By 2015, Hispanics will represent a greater proportion of the population than will blacks. If Hispanics are able to wield political clout (similar to what the blacks exert at present), then the multicultural question becomes even more complicated in terms of incorporating the Hispanic experience, which itself is diverse (see "Demography"). At what point does the cultural diversity of "we are all one nation" ("pluralistic experience") transcend the politics of race? The question of enforcing and supporting educational equity and equal opportunity will be challenged by the political climate that emphasizes excellence and elitism. Further, multiculturalism is primarily an issue in large urban/suburban school districts that constitute the overwhelming majority of school enrollment--it is not an issue in other communities.

### **Tracking**

Tracking, grouping by performance rather than "race mix," will be abandoned in the near term since it is claimed to be discriminatory and disadvantageous to at-risk youth and does not fare much better with other parts of the population. After the absence of tracking proves ineffective in improving educational achievement, tracking advocates will lobby for reinstatement, citing it promotes educational achievement and tracking will be resumed.

### **New Technologies**

The traditional classroom environment will change as the array of education delivery systems expands. Classrooms run by proprietary schools will remain, but developments in telecommunications will provide educators with new options. Electronic links between distant locations, that is, "distance learning"--the live delivery of instruction from one distant site to another via satellite with audio and/or video interaction between students and teachers--will proliferate, as will the use of computers, satellites, fiber optics, interactive television and videodiscs, cable television, electronic bulletin boards, and electronic mail. Closed circuit and cable tele-courses will become commonplace, and videodiscs and videotaped "telelessons" will enhance, supplement, and, in some cases replace textbooks and written materials. Students will access, via laser disk or telephone, a central learning center equipped with high-speed computers that can communicate in any learning resource center worldwide. Computers in the classroom can be used as tutors, or for simulation and gaming. The more familiar uses of computers can provide practical applications for instruction. Tutorial applications can promote higher order thinking skills. Training will become problematic.

Schools will need to adopt these new technologies in order to offer more extensive and intensive curricula. Steps must be taken to ensure the effective use of new technologies and learning theories. This mix of technologies must also be taken into account in planning both curriculum and facilities.

State-mandated curriculum changes (and eventually a national curriculum framework) and more

rigid high school graduation requirements will drive distance learning. New technologies will enable schools to meet curriculum requirements, offer courses where there are teacher shortages, and similarly provide inservice training that might otherwise be unavailable. Telecommunications networking is particularly attractive for small and rural schools.

The proliferation of these rapid technological changes will likely be inhibited by lack of funding. Large increases in federal funding will be needed if the United States moves to a national telecommunications infrastructure for distance learning. Although new technologies have made systems increasingly affordable, cost factors will influence the acquisition and spread of the new educational environment. Long-term payoffs are often sacrificed because short-term outlays cannot be made. Costs are influenced by instructional design, system scope, existing infrastructure, partnership and cost-sharing arrangements, system engineering requirements, financial arrangements (such as to lease or to buy), programming, and training. Annual subscription costs, upgrades and updates must also be considered. Many states cite lack of funding as inhibiting improved and increased use of technology in their schools.

The federal government and state regulatory agencies will need to adopt new, flexible, and effective policies that address the use of technology for education. Currently, federal and state telecommunications policies limit the number and kind of telecommunications services available for distance education.

The Star Schools Act sought to establish multistate, organizationally diverse partnerships to write and deliver both core and enrichment curriculum and to provide opportunities for disadvantaged students to receive remote instruction. The program, passed by the 100th Congress in 1988, funded four multistate, public/private partnerships for distance education and set as its goal "... address[ing] two critical needs in the rebuilding of our educational system to meet domestic and international challenges. The Nation's students must have access to basic and advanced courses in mathematics, science, and foreign languages, and these courses must be of the highest quality."

## NON-ACADEMIC SERVICES

### Health and Social Services

The role of the school has changed over time. "Even in particularly effective schools, family background is the best predictor of student achievement."<sup>[39]</sup> The breakup of the two-parent family, the growing culture of drugs and violence in our schools and society, and the increasing number of children having children, has led to an extension of the school's role. Schools now deliver a variety of services outside the traditional educational environment such as child care and parenting education, nutrition and health care, and substance abuse treatment.

The role of public education in these non-traditional areas is problematic, both in terms of funding

and as a matter of appropriateness. For the children of minorities and disadvantaged populations who are at risk, these services are essential. These programs may detract from instructional time and may effect extension of the school day and the evolution of the school as family substitute (particularly in urban and inner city schools). Lack of these services will cause larger societal problems (and more costly measures) later on.

Preprimary, social service "education" programs, viewed as beneficial "preventive" measures, began as federal initiatives. Funding has now become both a federal and state responsibility. Preprimary education directed at disadvantaged segments of the population seeks to prepare these children for elementary school instruction. Chapter 1 programs such as Head Start, that target preschool children, have been supplemented by the Even Start initiative. Even Start combines basic education for parents (those in adult literacy programs) with school readiness training for children ages one through seven who may be educationally at risk. Even Start seeks to boost the academic performance of disadvantaged children by identifying the medical, nutritional, and other social problems that might inhibit a child's success in school and in the long run reduce crime and save taxpayer money. The goal is to provide long-term payoffs by giving disadvantaged youths a better chance to become productive citizens. The price paid for not funding such programs will be higher in the future, when disadvantaged youth become nonproductive members of the work force.

### **Kindergarten and Pre-school Programs**

Statistics show that the percentage of three- and four-year olds attending preschool increased from about 14 percent in 1967 to 38 percent in 1987, and, as a consequence of increased enrollment, the preparation for formal schooling--"readiness"--also has improved.

Most preschool programs are private and attended by predominantly middle class, nonminority populations. The acknowledged disparity in educational performance between those attending preschool (an advantage) and those without preschool experience (a disadvantage) will pressure many public school systems to provide prekindergarten programs for all children. The number of public schools offering preschool education programs will expand, but fiscal restraint will limit growth. Prekindergarten programs with "educational" curricula will increase.

Although most kindergarten programs already have high enrollment rates, kindergarten may become mandatory in the next century. The kindergarten program will become more "academic."

### **OTHER INNOVATIONS**

#### **Expanded School Day/Year-round School**

The length of the school day and the school year in the United States, a holdover from the

nineteenth century, is shorter than that of the industrialized countries of the Pacific Rim that outperform the United States in international comparisons. There are obstacles, however, to extending the school day and the school year: money, teachers' unions, businesses desiring cheap labor over summer holidays, and other special interest lobbies, such as the recreation industry.

An expanded school day and extended school year will become a contentious issue although it was recommended by The National Commission on Excellence. The need for a longer school year may be mitigated by a redirection and refocus of the curriculum and greater flexibility by all concerned parties. An expanded school day/term may be combined with various programs. Those who wish for an extension of the academic school year may choose to do so. Greater flexibility in the school calendar is another reform option. Some students (most say the more academically oriented) will choose a longer school year. An extended or flexible school calendar that includes various scheduling options, however, will not show positive results, that is, achievement gains, unless educational goals are revised, since time on task is not the only issue.

### Apprenticeship/Intern/Service Programs

Apprenticeship and intern programs, to include federal, state, local, national construction corps, and community service--will continue to exist as options (not necessarily integrated into the educational setting), but funding levels will not expand and changes--vis-a-vis European models--will not be adopted. If the business community sees efficacy in apprenticeship and lobbies prodigiously, programs will become even more widespread.

These programs are possible components of a flexible education. The incorporation of an internship or national service into the high school curriculum would produce more well-adjusted, functionally literate members of society. Such measures will probably not be adopted. There may, however, be some regional experiments with these types of programs--most likely as business partnerships.

Pressure for business and industry to become more involved in education will increase. As a result, schools will be better connected to workplaces and have more links with the business community. Mentorships must become more widespread.

It has been suggested that the United States adopt an apprenticeship system, such as that in Germany, as a means of developing a national skill-building partnership between public schools and business. High schools in the United States typically lack an elaborate job placement system, and the majority of vocational students end up in jobs that have little or nothing to do with training received in high school.

A national apprenticeship system would be aimed at expanding the supply of skilled workers, narrowing the earnings gap between college and non-college youth, establishing new incentives to remain in high school AND to do well, and offering disadvantaged youths a realistic alternative to a life of early parenthood, drugs, and violence. In the tenth grade, students would choose between apprenticeship or an academic track. In the eleventh grade, students would combine on-the-job training with school. In

the twelfth grade, students would be in their third year of apprenticeship, with 75 percent of the time spent on the job and the remainder of the time spent in high school or a community college. At the end of the twelfth grade, students would take a comprehensive test to ensure their jobs as well as to measure educational proficiency.

## CONCLUSION

Demographics--the primary change driver--will influence both the trends in education and the reforms (see fig. 1). The increase in the number and proportion of disadvantaged youth, who traditionally belong to minority populations, will be the most important factor in the school-age population. Public education in the 21st century may largely serve minority and disadvantaged populations. The United States is committed to the fundamental concept of providing public education, but the system itself may polarize. Those who can afford the option will send their children to private schools.

Education reforms move slowly. Although targeted at improving the process of education, some reforms face the resistance of education bureaucracies, others meet funding obstacles. Some changes will take a long time to measure in terms of results; other reforms lack adequate devices of measurement. By 2015, the educational achievement level of U.S. youth will likely show little or no gain over present levels, and preparedness for the work force (and military) will still remain wanting. Since the decline in achievement levels cuts across society and affects a work force over a period of some 50 years, this shortfall is enduring, and as previously noted will depress productivity well into the 21st century. As the issue of educational equity comes to the fore, education may become more of a societal leveler. Disadvantaged and at-risk youth may increase their achievement levels (gradually and marginally), higher achievers may not make great gains, and those in the middle may remain predominantly average.

The present education system--initially based on reading, writing, and arithmetic (not mathematics), organized independently into units of instruction, was devised when the United States was an agricultural nation, and has since changed to meet the needs of the Industrial Age. The future education system, however, must be revised to meet the needs of the Technological Age--one of global interaction and interdependence--in banking, industry, production, resource allocation, communication, and information processing.

Future education programs must be dynamic and reflect the nature of change in the environment. Students must be taught to acquire knowledge and skills in critical thinking, reasoning, language, mathematics and science; to organize thoughts and solve problems systematically; and to write and communicate effectively. They must be versed in good citizenship and community service, understand their physical environment, the individual and society, and possess the attitudes and norms of behavior--social interaction skills--that allow a person to function effectively on a job. And, while the U.S. business community has adapted to meet the needs of the changing international environment, the 8:00

am to 3:00 pm school day, and the 180-day school year has remained the same. The need for a longer school day and school year is becoming more apparent.

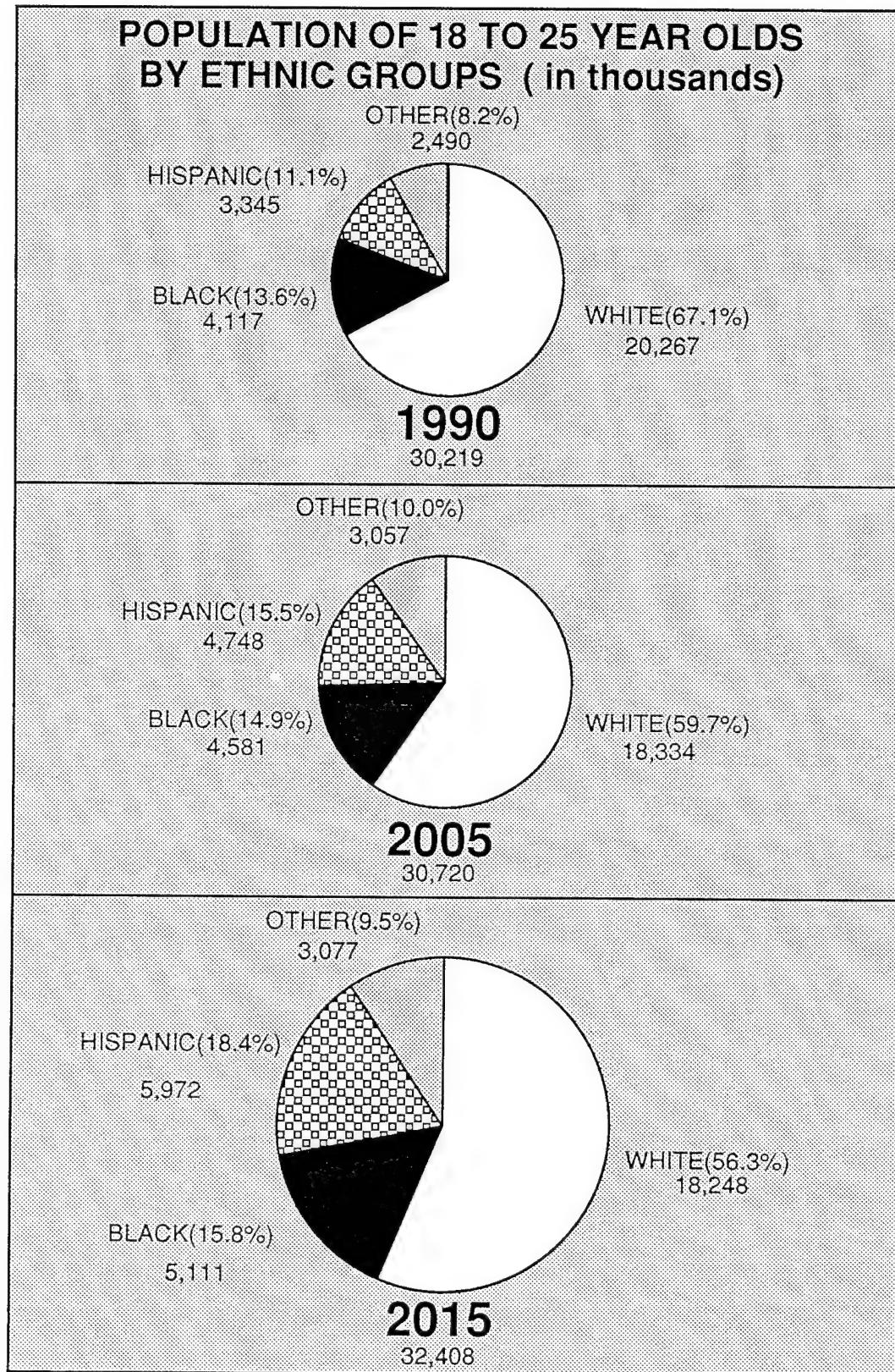


Fig. 1

White males traditionally have higher educational levels and higher salaries than other segments of the population and have been the most employable. In the late 1980s, white male workers constituted almost half of the work force; by the year 2000, they will account for only 15 percent of new job entrants. The growth of the black and Hispanic labor force will far outpace the growth of the white labor force. By the year 2015, more workers will be women, blacks, and Hispanics; white males will be in the minority. The same pattern will be evident in school enrollments.

**Table 1. Age 17 Cohort by Sex,  
1990, 2005, 2015  
(in thousands)**

Ethnic Group	1990		2005		2015	
	Male	Female	Male	Female	Male	Female
White	1,121	1,061	1,217	1,148	1,089	1,024
Black	253	244	310	290	329	307
Hispanic	194	186	314	300	372	355
Other	149	137	201	193	257	247
<b>TOTAL</b>	<b>1,717</b>	<b>1,628</b>	<b>2,042</b>	<b>1,931</b>	<b>2,047</b>	<b>1,933</b>

Although the manpower requirements for the army will decrease and the number of potential applicants will increase, the military may not have a more functionally literate pool to choose from. The proportion of at-risk youth, in relation to the rest of the population, will pose a growing threat to the effectiveness of the education system. Reforms will have to move at a quicker pace in order to improve the product of American education. As Soviet gains in scientific achievement, specifically Sputnik, challenged the U.S. education system in the 1950s and galvanized the country into action, the loss of competitiveness in the international economic arena (particularly to Japan and Europe) may spur U.S. education into the 21st century. Economic conditions, however, may make the military a more attractive option, and the military may not be faced with recruiting from a less than attractive pool of applicants.

## **APPENDIX A**

### **EDUCATION: THE JAPANESE APPROACH**

In Japan, schooling emphasizes diligence, self-criticism, and well-organized study habits. The belief is ingrained that hard work and perseverance yield success in life. Much of official school life is devoted directly or indirectly to teaching correct attitudes and moral values and to developing character, with the aim of creating a citizenry that is both literate and attuned to the basic values of culture and society. Starting pay for school teachers is higher than any other public servants in Japan, and higher or equal to that of engineers.

The Japanese believe that compulsory schooling must provide equal educational treatment of students; that all children have the ability to learn the material; that effort, perseverance, and self-discipline, not academic ability, determine academic success; and that well-organized study habits and good behavior can be taught. A nationally designed curriculum exposes students to balanced, basic education. There is also a relatively equal distribution of financial resources among schools.

The education system is characterized by high enrollment and retention rates throughout. School is compulsory and free to virtually all children from grade one through nine. Upper secondary school, from grades ten through twelve, though not compulsory, attracts about 94 percent of those who completed lower secondary school. About one-third of all Japanese upper secondary school graduates advance to post secondary education—to full four-year universities, two-year junior colleges, or to other institutions. The rigors of the entrance examinations and the cramming sessions preparing students for them are well documented.

The most common type of upper-secondary schools have a full-time, general program that offers academic courses for students preparing for higher education and also technical and vocational courses for students expecting to find employment after graduation. More than 70 percent of upper-secondary school students enrolled in the general academic program in the late 1980s.

Japanese children attend school five full weekdays and one-half day on Saturdays. The school year has a legal minimum of 210 days, but most local school boards add about 30 more days for school festivals, athletic meets, and ceremonies with nonacademic educational objectives. The number of days devoted to instruction is about 195 per year.

## **APPENDIX B**

### **GENERAL EDUCATIONAL DEVELOPMENT CERTIFICATES**

The number of people who earn General Educational Development (G.E.D.--high school equivalency) certificates dropped 25 percent in the 1980s. In 1980, approximately 816,000 people took at least one part of the five-part examination; approximately 500,200 earned diplomas. In 1989, approximately 682,700 people took some part of the examination; 376,880 earned diplomas. Of those who took all portions of the test, 70 percent passed the examination in 1980, compared to 68 percent in 1989. The percentage of 17- to 18-year-olds taking the G.E.D. from 1977 to 1987 increased as the test became better known and more widely accepted as an alternative to a high school diploma. In 1981, 711,000 people took the G.E.D. and 72 percent passed; slightly less than one-third of the test takers were 19 years old or younger. Many of those who passed the G.E.D., however, had only a sixth grade reading level.

By the 1980s, the biggest drop in the number of G.E.D. examinees was among adults ages 18 to 24. In 1980, 519,000 people of this age group took the G.E.D.; in 1989, only 380,000 people took the test. Some educators speculated that the addition of an essay section to the G.E.D. in 1988 made the test more difficult and may have scared off potential test takers. Educators also believe that many young adults are unfamiliar with the exam and might be more interested in landing jobs and earning money quickly--as entry-level jobs can be gotten without high school or equivalency diplomas--than in educational achievement. There has also been speculation that the G.E.D.'s credibility may have inadvertently been damaged by the military. Since 1970, the services have been working to reduce their attrition rates and they have given higher priority to recruiting people who have graduated from high school. Statistics show that high school graduates are more likely to remain in the armed forces than recruits with G.E.D. diplomas.

G.E.D. candidates mirror demographic trends. An increasing number of test takers were Hispanic--6.8 percent in 1980, but 11.2 percent by 1989. The number of test takers who are black has declined over the last decade--from 17 percent in 1980 to 14.2 percent in 1989.

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## KEY JUDGMENTS

### AMERICAN SOCIETY IN 2015

— Two powerful trends will profoundly affect American society in coming decades: the ever-increasing interconnectedness of the world economy and the steady aging of the U.S. population. Economic globalization will challenge U.S. businesses on numerous fronts. The aging population will make great demands on U.S. resources, both material and human, through increased needs for pensions and medical care.

— Increasing globalization of the economy will mean that business activity will no longer necessarily benefit the U.S. workforce. Corporations may be headquartered in the United States, but their manufacturing activity will be undertaken elsewhere. A decline in the overall standard of living is likely.

— Declining living standards will not be limited to manufacturing jobs, but will reach white-collar workers as well: the increasing use of computers may create "electronic sweatshops." The need for higher productivity and profitability will lead to further compression of the middle management positions, indicating fewer employment opportunities for mid-level professionals, hence a lack of upward mobility. A two-tiered American workforce will gradually appear: one, relatively small, prospering in the new harsh global economy; the other, perhaps three-quarters of workers, able to find only low-paid and insecure employment. The buoyant optimism characterizing American society since its inception, could be extinguished and create social tensions without precedent.

— The traditional nuclear family will make up only one-fourth of American households. The increase in single-parent families, headed by a woman and having serious economic concerns, is a persistent trend. Many of these families will be found in the military and additional family services will need to be provided.

— The increasing number of retirees and the shrinking labor force (a concomitant decline in the fertility rate and dramatic increase in longevity) will intensify economic (tax) pressure on workers. Also important is the fact that the vast majority of retirees will be white and a higher percentage of workers supporting retirees will be nonwhite. Racial and ethnic conflicts could develop.

— The U.S. Army will have a smaller pool of potential recruits, but may reap the benefits of uncertain economic fortunes: in a harsh economic climate and stable long-term employment more unlikely, the Army may have the top-quality pool for recruits. This, coupled with the need for fewer recruits (assuming the Cold War rivalry with the Soviet Union has ended), could ensure that the Army will have a substantial pool of high-quality applicants from which to choose.

## AMERICAN SOCIETY IN 2015

### INTRODUCTION

This paper begins with several assumptions: the assumption that there will be no disruptive world war or gigantic natural catastrophe in the next decade or two; that the Cold War will come to an end in the 1990s and that there will be no nuclear war between the superpowers, whether intentional or accidental; and that no crazed Third World dictator or terrorist group will detonate a nuclear device or unleash germ warfare within the boundaries of the United States. The latter action, not impossible in coming decades, could kill millions of Americans and make whole regions of the country uninhabitable.

The assumption is, then, that the world of the new century will develop peacefully out of the world of today, and that the only warfare experienced by the major industrialized countries will be commercial in nature. Western Europe will unite to become a powerful commercial bloc, the Pacific Rim will be even stronger economically, and the United States will have its hands full competing in an ever more interconnected global economy.

In this view, the great over-arching change driver in the coming decades will be the challenges this new global economy presents to the United States. Americans' lives will be altered by their country's attempts, sometimes successful, sometimes not, to hold its own in a much harsher economic climate. The country's future commercial dominance is no longer assured, and the lazy business practices and casual government trade policies so prevalent in the past will no longer be sufficient. The 1970s and 1980s were hard decades for the American economy, and in numerous areas, technical and commercial, the United States no longer came in first place in the global economic race. No trends indicate that the next decades will be any less challenging.

The trade wars of coming decades will demand much from the United States. However, the military role the United States began to play during World War II and maintained up until the virtual collapse of the communist system within the Soviet Union is likely to be no longer necessary, at least on such a broad scale. This fact will allow the United States to direct its energies to meet the challenges posed by the global economy, challenges that will force the country to adapt itself to new economic conditions if it wishes to retain its geopolitical dominance and ensure its citizens a high standard of living.

In the view of many analysts, the situation is stark. A nightmare scenario is that the United States will fail to meet the challenge, and, like so many great powers of the past, will enter a period of decline, coming over time to resemble Third World countries that sell raw materials and foodstuffs and import finished goods. On the other hand, some futurists of the "gee whiz" variety predict that this country will, in the course of the next few decades, transform itself into a post-industrial, high-tech society in which an educated population performs satisfying and well-paid work and leads a life of self-fulfillment and ease. This forecast is not likely to come to pass, given the recent economic trends mentioned above, unless the United States undergoes a dramatic transformation in the next few decades. Unfortunately, another scenario is more likely: the United States will remain a manufacturing country,

but only for certain products, and much of this production will be managed by firms with foreign ownership. Some American firms will remain leaders in their specialties, but their focus will be global, rather than domestic. Production will occur where it is most advantageous, and the "Americaness" of these firms will be only a souvenir of their past history and the location of their headquarters.

The America of this scenario will differ from the America of the past in that the country's traditional belief that all citizens have a good chance for economic betterment will no longer conform to reality. The society emerging from this dark scenario will be an Orwellian vision of a prosperous minority and an impoverished majority.

The new society's elite minority will have the skills needed to thrive in the global information/service economy. The members of this elite will have work that is pleasant, stimulating, and well paid. They will apply their ideas and talents wherever they bring the most advantage; because of telecommunications, international boundaries will not exist for them. Their companies will scour the earth for business opportunities, and production will be located where conditions are most favorable. Profits will accrue to the skilled minority. Their offspring will have access to fine schooling that will permit them to follow their parents' careers.

The poor majority, however, will not be able to meet global challenges, will not be able to compete with the low wages paid in the Third World, and will not possess the highly specialized analytical skills that would make them valuable to the new global economy. The majority will have to be content with dead-end occupations and work as menial physical laborers, low-grade service personnel, industrial assembly workers, and routine operators in "electronic sweatshops."

Analysts fear that these workers, perhaps as much as 80 percent of the work force, will have access only to a mediocre school system, ill-equipped to train them in skills that would make them competitive in the global economy. Forced to take low wages because their talents can be bought cheaply abroad or are readily available domestically, the majority of the work force will have a declining standard of living. The high wages enjoyed by ordinary wage-earners during the first three or four decades after World War II will be only a dim memory for this new underclass. [40]

If existing economic trends continue, this bleak scenario of America's future could become reality. The 1980s saw, for example, a decline in the living standards of many ordinary working Americans, many of whom are living no better than they did in 1970. In the 1980s, the United States became the world's greatest debtor nation and endured an unbroken string of trade deficits. The country's national debt tripled, its prison population doubled, and its technical and business dominance in many areas was lost. Many Americans came to feel that their country had somehow lost its way, and they wondered whether their social and governing institutions were adequate.

Given these unfavorable trends, some observers have concluded that American society is reaching a crisis point, that the 1990s will be the decade in which the country must change significantly if its ordinary wage-earners are to retain their privileged place in the world. The challenges posed by the new global economy could be the change drivers that would transform this country in the coming decades. These challenges might cause American society to become more efficient and solve its problems

n the most effective way possible. Waste of resources, human and natural, could be reduced to a minimum as the United States seeks a secure future. A further result could be that social problems will be examined with new eyes, new solutions developed, and new methods devised to implement these solutions.

Many of these new solutions will be unpopular for they will break with established ways of thought. Their implementation will require public support, however. Securing this support will require much dissemination of relevant information about the workings of a complex society, much discussion and argument, and trust in the decisions of an informed public. The serious challenges posed by the new global economy will perhaps heighten the overall social consciousness and permit bold and creative decisions to be made.

There is almost universal agreement that the United States of the early 1990s is confronted with many serious social problems. Increased incidence of crime, growing health care needs and costs, deficiencies in the education system, budget deficits, a decaying infrastructure, an aging population, entrenched urban and rural poverty are the most obvious problems. There is not yet, however, much agreement about how to deal with them, and this lack of consensus is in itself a serious problem. However, the country's tradition of practical optimism makes it possible that solutions will emerge.

One social trend is certain for the America of the next century. That great bulge of population growth, the Baby Boomers, the 76 million Americans born between 1946 and 1964, is aging. Its oldest members will become 55 in 2001 and 65 in 2011. Its youngest member can be expected to die at an advanced age about the year 2068. The aging of the baby boom will have profound effects on virtually all aspects of American society. It will be a change driver of unforeseeable dimensions.

Americans over 65 will take an ever-increasing share of the federal budget. In 1940 this group received 2 percent of federal expenditures; in 1970 20 percent; in 1989 27 percent; and in 2001 an estimated 30 percent. By 2015 their share will be approaching 33 percent. They will receive government funds for their pensions and their health care, and, when they are no longer able to care for themselves, for there nursing home care. As they become an ever greater segment of the population, the expense of their maintenance will increase almost exponentially, for there will be an even larger number of "old-old" people over the age of 80, already the fastest growing group in America.

By 2015 there will be more than eleven million of the old-old, an age cohort that requires much personal care. The prevalence of the old-olds will alter the overall social needs of the elderly. In 1985, 90 percent of the elderly could care for themselves; by the year 2000 only 80 percent will be able to do so. Specialists estimate that one 100-bed nursing care facility will have to be built every day during the 1990s to meet the growing needs of the elderly.

Many other needs of the aging population will cause similar shifts in the expenditure of time and resources: human, material, and financial. The "graying" of the population will affect all segments of society: how it lives, its way of doing business, its politics, its allotment of housing, its way of spending leisure time, and its values.

These two overarching trends, the growth of a competitive world economy and the aging of

America, will affect the military establishment in numerous ways. The aging population will also take an ever greater share of the country's wealth, in addition to no longer being a source of production itself. In short, fewer resources will be available for military purposes. If the assumption that the Cold War will wane is correct, then there may be a lessened need for as large a military establishment. Even so, the scramble for resources to maintain a smaller, but professional and high-tech military will be intense and potentially polarizing in the crisis situation facing the United States in coming decades.

While a military force of some sort will always be essential, military power alone will not be a key factor in determining a country's strength in an era of strong commercial rivalries. Countries with strong economies will be independent; countries with ailing economies will fare poorly in coming decades. The Soviet Union is a military giant, yet it cannot feed its people. The military power of the United States cannot stop the decay of the old industrial zones of the northeastern parts of the country or cure the social blight of the inner cities. In the face of pressing domestic needs that if not addressed threaten this country's health, the military will have difficulty obtaining its desired share of national resources.

## SOCIAL STRUCTURE

### Family

In the first decades of the new century, the traditional nuclear family of husband, wife, and their natural offspring will be the exception rather than the norm. This fact is already the case at the beginning of the 1990s, when the "traditional" family makes up only one-fourth of households. The frequency of divorce, later marriages and remarriages, relaxed attitudes about extramarital sexual relations, a disinclination to marry on the part of many, women's entry into the work place, and the large numbers of elderly with deceased spouses are reasons for the declining prevalence of the traditional family. Because there seems to be little reason to believe that any of these social trends will diminish, the traditional nuclear family will probably retain its minority status in coming years.

A very disquieting social trend almost certain to continue into the future is the upsurge of illegitimacy and single-parent families that took place in the 1970s and 1980s (see Fig. 1). During these decades, the U.S. rate of illegitimacy became the highest in the industrial world and yielded a new social subgroup of largely fatherless families. This social subgroup showed an unusually short generational span. Most of these mothers were teenagers when they first gave birth; they became grandmothers in their mid-thirties and great-grandmothers by the age of fifty.

It is likely that the prevalence of illegitimacy will continue to be socially significant in the next century. There is little reason to assume a transformation of popular attitudes about sexual morality. American society is now so secular that religious strictures relating to sex have little credence, especially for sexually active youth. The economic conditions that make obtaining properly paid employment so difficult for many minorities are likely to continue, with the result that many minority males will not be

able to earn enough to support a family. The establishment of an extensive program of effective sex education for America's youth, coupled with a wide dispensing of contraceptives, could reverse the prevalence of illegitimacy. The provision of better paying jobs for minorities could reduce the number of single-parent families. Given the challenging economic conditions of the next decades, and the controversial nature of these social programs, such measures will be difficult to effect.

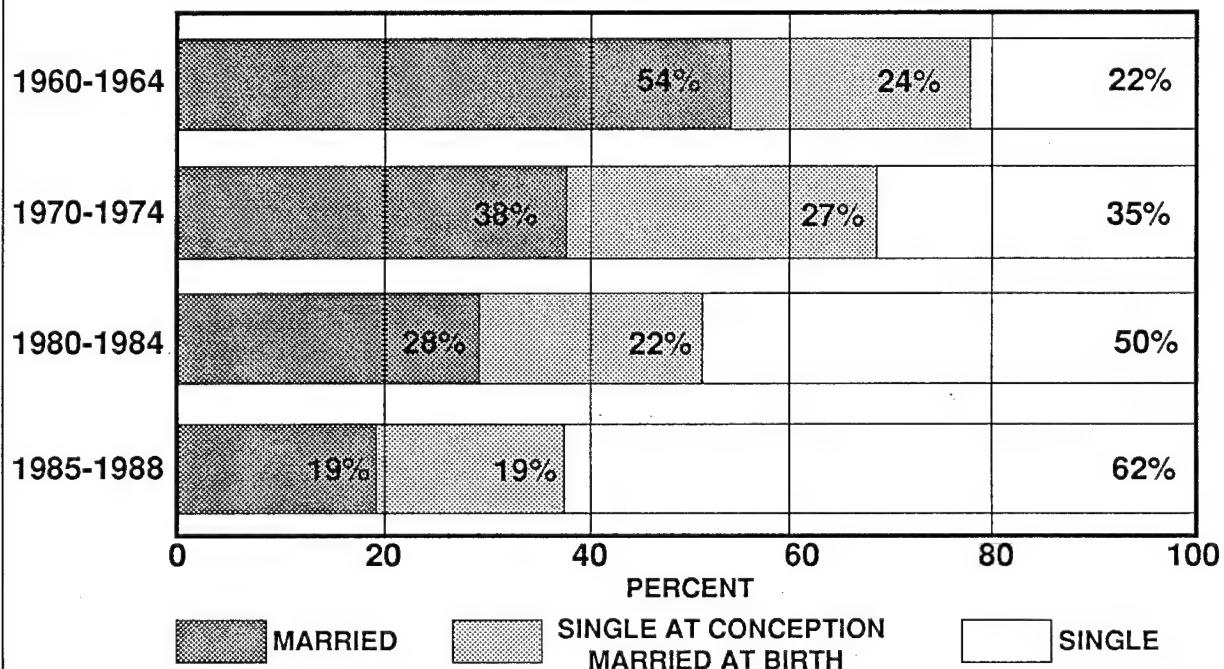
The American family is not in danger of extinction. It will continue to be the core unit of society in the next century, but trends indicate that it will exist in a variety of forms. Communal arrangements, homosexual marriages, transgenerational unions, as well as and other types of families will be common. Specialists believe, however, that three family types will be dominant in the early years of the next century.[49]

Closest to the traditional family unit will be first marriages, usually entered into after the couple has lived together for a time. Cohabitation, relatively rare in mainstream America as late as the 1960s, will likely come to be acceptable and unremarkable by most people in the next decades. Figures illustrate an already substantial change in attitudes. In 1964 only 11 percent of couples had lived together before marriage; two decades later, the figure was 44 percent. Employment trends also make for differences. Unlike what was true in most marriages in the first decades after World War II, both spouses will be employed, and perhaps a quarter of these marriages will be childless. Only better-off families will have the economic means for mothers to remain at home and care for the children full-time.

A second type of family, the single-parent family, will be a result of separation, divorce, or illegitimate births. Families of this type will usually be headed by a woman, have serious economic worries, and occur with the highest rate of frequency among blacks.

Most people who divorce eventually remarry and their new unions will create "blended" families, the third most common family type. These families will consist of offspring from earlier marriages and whole sets of step-relations. One specialist has estimated that over 60 percent of the children born in the late 1980s will, at some time in their childhood, live in such families. "Blended" families are not especially stable and will yield more divorces and remarriages and even larger "blended" families, the size or form of which depend on each family member's position in a large and complex system of kinships. A divorced woman, for example, is not likely to regard her former spouse as a family member, but her children will if they see their father on a regular basis. Furthermore, they will regard his relatives as part of their extended family. In effect, they will have another family apart from their mother. A family of this type is very different from the traditional nuclear family, with its two parents and four grandparents. Children may emerge from it insecure and emotionally distant, or they may thrive on the stimulation provided by the wide variety of relatives with whom they come into contact.

**MARITAL STATUS OF TEEN MOTHERS\***  
**AT FIRST BIRTH 1960 TO 1988**



\* BIRTHS TO TEEN MOTHERS AGE 15-19.

Fig. 1

Some observers of the American family see a rebirth of the extended family through the closer involvement of older people, not just grandparents or blood relatives, in the lives of families. The large numbers of older, yet healthy and energetic, persons in the society could assist the small nuclear family. The presence of caring older people could alleviate the need for child care centers, for example. The existence of laws in all states that protect grandparents' rights to see their grandchildren indicates the increasing importance of older people in the raising of children. Another such indication is the increasing use of older people as volunteers in schools. In a society of scarce resources, older people will have more to do in the next century.

These family trends pose difficulties for the military. The trend toward a multiplicity of family types will make the provision of family services difficult to plan. The prevalence of single-parent families will be seen in military families as well and could make the quick deployment of such parents almost impossible if there is no extensive support system of child-care facilities. A soldier concerned about the welfare of his or her children will not be totally effective. The lack of family stability in soldiers' lives will also affect job performance. A further worry is that the offspring of fluid families will be maladjusted and bring their personal problems with them into the military when they become soldiers.

Soldiers from single-parent families may have suffered deprivations in their childhood and may be rather troubled individuals. A special difficulty for the military is that many of the young people from families of this kind will not have had a strong authority figure in their lives. For some the military, with its set hierarchy, will be a welcome refuge, offering security for the first time in their lives; others will find discipline intolerable.

The emerging trends in the American family are so new that their social results are still uncertain. The military establishment will cope with them as best it can. The old army that consisted to a large degree of young unmarried male conscripts is long gone. It could perhaps be resurrected through a reintroduction of the draft and gradually reducing the number of military families. Resource shortages may preclude the many and expensive benefits now offered to military families and destabilizing family trends may make the military's present policy of relying on a large professional force consisting of married soldiers of both sexes an impossibility in the next century.

#### Generational differences

In the America of the next century, older people will outnumber the young. The median age of Americans will rise, going to 37.6 in 2015, compared to 25 in 1965 and 30 in 1980. Some calculations indicate that there are presently 28 million Americans over the age of 65; by 2020 there may be 60 million. The number of very old, that is, over the age of 85, will increase sharply. At the present time about 9 percent of those over 65 are 85 or more; around the year 2015 this figure will increase to about 17 percent.

The maturing Baby Boomers will be, for the most part, fairly well set by the next century. Their housing will be paid for. Pensions will have been arranged for the first wave of retirements.

Many of these older Baby Boomers will be in excellent health and quite active for the first decade or two of their retirement.

The huge numbers of Baby Boomers will mean that the basic mood of the country will be different, for, as always in their life, the Baby Boomers will be the defining center of American society. When they were young, Baby Boomers were the *raison d'être* of suburbia, the lifestyle that emerged after World War II. In the 1960s and early 1970s the first Baby Boomers reached the independence of early adulthood and by their way of living established the youth culture. Some of them were active protesters against America's involvement in Vietnam. Many others were, at least for a time, members of the counterculture. In the 1980s, some of the younger Baby Boomers became yuppies and colored an entire decade by their material success and buying habits.

The maturing Baby Boomers will cause the 1990s to be a more placid decade than the preceding ones. Most Baby Boomers will have established themselves, for better or worse. Their large numbers will cause ever more businesses to abandon the diminishing youth market and attempt to meet the needs of a rapidly maturing population. The maturing of this great age cohort should cause American society to become more reflective and stable, as a middle-aged generation becomes dominant.

In the first years of the 21st century, the first Baby Boomers will begin to retire. Their material concerns are likely to have been largely taken care of, and the older Baby Boomers may, in the opinion of some specialists, return to the political and ethical concerns of their youth. Raised in the largely carefree 1950s and 1960s by their doting parents, and allowed to be independent-minded, older Baby Boomers are often idealistic. Making their way in the increasingly difficult 1970s and 1980s forced them to worry about earning a living and raising their children. The 1990s are expected to be a difficult decade economically for the United States, but many older Baby Boomers, because of when they were born, will have decent employment and housing by the time this decade began.

According to this proposed scenario, these older Baby Boomers will examine their society and their lives, look for ethical coherence, and perhaps bring to American society a new surge of high-mindedness. Largely free of material worries for themselves, just as they were in their youth when the American economy seemed to promise an ever-increasing standard of living for all, these matured Baby Boomers may seek again to reform American society. [42]

This scenario may prove unfounded. Older people often become conservative with age and, with diminishing vitality, more pessimistic and guarded about what is possible or desirable in society. Matured Baby Boomers may seek only to ensure their own well-being. Faced with the obviously worsening problems of how to care for an aging America and meet pension and health care obligations, this generation could become an obstructive force in American society, avoiding the sacrifices and preventing the fundamental reforms needed to equip the United States to deal with the very serious pension burdens that will become critical in the second and third decades of the new century. The following figures show the potential size of this burden. In 1987 each Social Security retiree was supported by a 10.1 percent payroll tax on 4.8 workers; in 2027 one estimate sets these figures at 17 percent and 2.3 respectively. Cost trends of this nature may not bring out the best in people.

Younger Americans are likely to have a lower standard of living than their parents. Their housing will be less good and their career prospects less bright than those of the older generation. It will be on their shoulders, however, that the older generation will rest. The growing costs of pensions, the older generation's need for medical and nursing care, and the nation's worsening dependency ratio may fuel resentments in young workers. It is not at all certain that they will be willing to work quietly to support their elders.

### **Class/Race/Gender**

#### **Class**

To a remarkable extent, American society has been freer of resentments stemming from class differences than many other societies. There have always been economic classes in the United States, but to degree greater than elsewhere, there has been movement between classes. Such movement has come about partly through a generally increasing standard of living that, in effect, improved everyone's social position and partly through the ability of individuals to climb the social ladder through their own abilities and industry. Except for the glaring anomaly of slavery, this country has never had a feudal system with its tradition of subservience. Hence, most Americans think their society offers them fair chances for betterment.

Some analysts question if this perception of social opportunity will hold in the next century. The coming information/service economy will be one in which advancement generally goes to those with highly specialized and expensive training. A further problem is perhaps even more serious. Some forecasts fear this new economy will require fewer skilled people than in the past, for automation will do many tasks formerly managed by skilled workers. In addition, some analysts predict that computers and instant communications will move information up and down a company's chain of command: the result will be elimination of many middle management tasks, with a consequent loss of jobs and potential advancement for lower management. Firms are thus likely to consist of small numbers of highly trained and capable managers with large numbers of workers performing routine and unskilled tasks.

After World War II many unskilled, but unionized, American workers were able to secure well-paying blue-collar jobs in a large manufacturing sector. This sector is rapidly declining in importance as a source of jobs. In the late 1980s, it supplied about 20 percent of jobs; by 2015, it will supply only an estimated 10 percent. Also in decline is the American labor movement and the well-paying jobs it helped guarantee. In contrast, many of the new jobs created within the service sector are badly paid, often only slightly above the minimum wage. [8]

In addition to lower wages, workers will have less security. The new global information/service economy will be less stable than the one Americans are used to, and employees will no longer be able to count on long-term permanent employment. Workers will often be required to switch jobs, firms, and geographical location to remain employed. Such shifting will hurt earnings and exact a psychological toll,

particularly on those employees who do not have a career, but are merely earning a living. Because most wives will be working, geographical mobility for displaced workers will also have an impact on marriages.

This scenario's forecast of reduced opportunities for occupational advancement and a scarcity of jobs paying enough to secure at least opportunities for the offspring of ordinary wageearners means a reduction of social mobility in American society. A result with potentially wide-ranging consequences could be an increasingly rigid social system in which the elite would become more self-recruiting and advancement from the ranks of ordinary workers more difficult.

A reduction of social mobility would soon undermine the long-cherished American belief that everyone has a chance for economic and social betterment and deprive the social system of the legitimacy that it has enjoyed even in the eyes of most poor Americans. A loss of legitimacy often means social unrest. Even during the Depression of the 1930s, the United States saw little revolutionary social turbulence compared to many other countries, for most citizens accepted the basic social order. Social unrest could become common in the new century if ordinary Americans felt that they had not been given fair economic and social opportunities.

Because it would offer young people from all social backgrounds chances for decent employment and social advancement, the military would likely benefit, at least in the short run, from a more closed American society. As other options became less readily available, young people would view the military as offering a career of steady employment, no longer common in the private sector, and perhaps as a means of obtaining valuable training and education. The military's emphasis on ability and accomplishment and its egalitarian traditions, combined with lifetime employment, would make it attractive to many. Hence, the military would have a large pool of applicants to chose from. In addition, because its general living conditions would contrast favorably with those of the private sector, the military would also likely have good morale and high retention rates.

## Race

The United States has made amazing advances in race relations in the decades after World War II. Although the country has not reached complete racial harmony by the beginning of the 1990s, the gains of previous decades in lessening racial prejudice and discrimination are grounds for assuming that substantial progress in this area will continue. Blacks, for example, made impressive gains in education, employment, and wage levels. Although, there are good reasons for dissatisfaction about many aspects of the social conditions that many blacks still have to endure, a sizeable portion of Black America belongs to the middle class.

Other minority groups have shown similar or even greater progress. For the most part, Asian-Americans have done very well. Their children have become proverbial "curve-busters" in California universities. The first wave of Cuban-Americans, those who fled Cuba in the early 1960s, have also prospered greatly in their new country. But like Black Americans, not all of these minorities enjoy high

living standards. Some Asians, the Hmong and Khmers for example, are having difficulty adapting to American society. Non-Cuban Hispanics also frequently meet with economic and social difficulties.

Minority groups are thus not monolithic, and there are no overall trends by which to chart their social progress. They differ greatly both within themselves and in relation to other minority groups, and their path into the future will vary. For example, they are growing at different rates. Black America has a higher birth rate than white America, but it is being overtaken by Hispanics, who sometime early in the next century are projected to become the largest ethnic group in America. Asian-Americans, for their part, have a higher birthrate than whites or blacks, but lower than Hispanics.

Poorer blacks and Hispanics do have some features in common. In the coming decades it is virtually certain that these two groups will reside to a great extent in the centers of metropolitan areas. In 1990 they were already in the majority in a number of large American cities and in the first decade of the new century, these two minorities will constitute a majority in just over half the country's 100 largest cities.

In the next century, most of America's new jobs will be located in the far-flung suburbs, far from the inner city. This trend will mean that many poor blacks and Hispanics will be hurt not only by their lack of education, but also by their distance from where jobs exist. For these reasons, then, the poor members of these two groups will continue to make up the ranks of much of the poor, having badly paid dead-end jobs, or little or no work at all. These two groups will form the most visible parts of the American underclass. The white members of this underclass will be much more dispersed, living mainly in scattered suburbs and in rural areas.

It is impossible to know with certainty what race relations will be like in the early decades of the next century. There are reasons both for optimism and pessimism. The economic strains resulting from the rigors of the global economy will be grounds for worry. There will be disagreements about the allotment of scarce financial resources. If there is not enough growth in the economy to carry all groups upward, then claims on the funds available for direct government intervention to help disadvantaged groups could be very keen and call forth racial resentments, already festering or dormant.

Grounds for optimism are the great material and social gains achieved by many members of minority groups in recent decades and their successful integration into mainstream American society. The lessening of racism in social institutions, most notably the successful attempts of the American military to ease racial tensions and create equality, is one of the most encouraging signs that the United States can become a peaceful, multiracial society. Young people, too, seem to be less prejudiced than their parents, a fact noticed by many specialists when young people of different races mix freely together. Interracial dating, still troubling to many people, is accepted by such youngsters as an ordinary everyday occurrence. In addition, modern media, such as television and the movies, allow America's many different ethnic groups the opportunity to become familiar with one another and hence reduce racial hostility. [30]

A final reason for hope is that the United States is committed by law to the equal treatment of all ethnic groups. If not always realized in practice, equal treatment is a widely supported principle and unlikely to be revoked in the foreseeable future. All ethnic groups have organizations manned by skilled

lawyers ready to represent and defend their rights in courts of law. On occasion the courts must deal with absurd or wrong-headed cases of alleged discrimination, but their obligation to do so protects the rights of all groups. Mutual affection may not result from these cases, but toleration and perhaps even respect do. There is no reason to believe that equality under the law will not be the case in the America of the next century.

The military will be much affected by the race relations within society as a whole. If they are good, the military will have an easier time ensuring that relations within its organization are smooth. Bad relations will make the military's task more difficult. In the past, however, the U.S. military has been a path-breaker in reducing racial discrimination, and there is no reason to assume that this tradition will not continue. If race relations in the United States became very bad, something that is not expected, then the military would be affected as well, perhaps to such an extent that it could not perform its tasks effectively.

The military is likely to be only marginally affected by the social problems of minorities. A smaller military will need fewer personnel, and screening procedures should allow the military to select only those likely to serve satisfactorily. Despite the smaller numbers of young people available in coming decades, the military will need fewer to fill its reduced size. The social conditions sketched out in the previous section would, if they come to pass, make military service attractive to youths from all social groups.

#### Gender

There are good reasons to be optimistic about women's place in the America of the future. The gains made by the women's movement in the 1960s and 1970s seem to be permanent. Although some segments of American society would like to see women return to being uniquely housewives and mothers, or, if they work, remain in the "pink ghetto" occupations of teacher, nurse, and secretary, most Americans have come to terms with women's rights. It is difficult to imagine any political movement that would seek to undo the social trends that have brought women greater equality in recent decades. In addition, economic trends have made employment outside the home a necessity for most women, married or not.

The gains of the women's movement in the last 25 years have been great, so much so that American society has experienced a virtual revolution in these years. As Table 1 shows [13], the number of women receiving college degrees and advanced degrees has increased almost exponentially since 1970, and women have entered the professions at an amazing rate.

**TABLE 1**  
**University Degrees Earned by Women in the United States**  
(in percentages)

Type of Degree	1970	1980	1990
Accounting	10	41	60
Business	14	34	55
Law	12	37	53
Medicine	15	28	48
Computer Science	24	30	48
Agriculture	7	29	35
Architecture	21	28	35
Engineering	1	9	25

Armed with college degrees, women have entered the professions at an unprecedented rate. Women's entry into the business world has been especially marked: in 1970 women represented only 1 percent of business travellers; by 1990, they represented 30 percent. Their share is expected to increase even more in the 21st century.

Women still hold relatively few top management positions. This situation will change in the coming quarter century as many of those who entered business in the last two decades acquire experience and reach the age at which people usually assume the highest positions. If for no other reason, the sheer number of women professionals will crack the so-called "glass ceiling" that up to now has limited a woman's rise to the upper levels of management.

Women will also excel in the running of small firms. Small businesses are a very important segment of the American economy, and they will grow more important in the future. At present, businesses with less than 100 employees employ some 80 percent of the work force. In the coming decades, smaller contracting firms will replace many of America's larger businesses. Women are already well represented in this area, having set up about one-third of small businesses on their own in the 1980s.

In the United States, women are still grossly under-represented on a percentage basis in politics at the national level. At the local and state level, however, women are winning an ever increasing number of elective offices, by some counts registering a 300 percent gain in recent years. It is only a matter of time until women come to hold many seats in congress, head government agencies, take a greater share of cabinet posts, and even are serious contenders for the presidency.

In some respects, however, women have done poorly and can be expected to do worse in the

future. Poverty has become ever more "feminized," mainly because women have increasingly become the heads of single-parent households. This situation is most true among Black Americans, where the number of unwed teenaged mothers among the poor has reached catastrophic proportions. The frequency of divorce has meant that many middle-class white women have also become impoverished.

Women's presence in the work place and the increase in the number of single-parent families will make the provision of childcare a key social issue in the 1990s. Not only will the civilian sector have to confront this issue, but the military will as well. Table 2 [29] illustrates how pressing this need has become.

**TABLE 2**  
**Number of Children with Mothers in the Workforce,**  
**Selected Years. 1970-1988**

Year	Under Age 6	6-13 Years of Age
1970	28.5	n.a.
1975	36.1	40.6
1980	43.0	55.7
1985	48.6	59.9
1988	51.5	62.7

Also certain to plague American society in the decades to come will be the many problems connected with the increasing number of unwed teenaged mothers. Possible remedies will cause much social discord and consume significant resources. Failure to assist the children and mothers involved will require even greater expenditures down the road into the next century.

The American military has been much affected by the revolution in women's role in society. It has made bold attempts to come to terms with this role, but so far with mixed results. In the first decades of the new century, the many women admitted to the service academies will be eligible to fill many of the military's top positions. This they will likely do, with only occasional friction, for the women promoted to these positions will be individuals who adapted well to the demands and circumstances of military life. Many other women will not have dealt so well with these conditions, and will have left the military earlier, probably at a rate higher than their male counterparts.

Arranging provisions to deal with military families will cause much trouble and perhaps require a reconsideration of policies now in effect. The lower pay of enlisted personnel, coupled with a less serious commitment to their careers, will cause many enlisted women with children to have a troubled

and only short-term service career. Given the possibility for a more peaceful world order in the next century, fewer U.S. service personnel are likely to be stationed abroad, but instead be deployed overseas for only brief campaigns. This situation will reduce stress on female soldiers with children, but not eliminate them. Family difficulties that showed up during "Desert Storm" indicate that new policies will have to be worked out if the military continues to allow women a service role nearly identical to that of men.

## SOCIAL WELFARE

The United States has many serious and worsening social problems. There is little argument about this fact, but much disagreement about how to deal with these problems. A key assumption of this paper is that the rigors of a highly competitive global economy will force the country to devise new ways to draw maximum advantage from its most important resource, its citizens. An unhealthy population, badly trained and poorly motivated, can only be a drag on the country's competitiveness. Hence, the press of economic necessity will be the change driver that pushes American society to deal boldly and creatively with long-standing social ills and render its work force as productive as that of its chief rivals abroad. Remedies now seen as controversial and experimental will be adopted to deal with social problems that traditional methods failed to cure. The devising of new means to deal with drug abuse will be an example of the trend toward a objective and rational solution of social problems.

Some specialists contend that radical means will be adopted within a decade or so to deal with the consumption of drugs that are now illegal. At the present time, drug abuse is devastating segments of American society. The war against drug abuse and trafficking has led to a doubling of the country's prison population in the 1980s; according to some estimates, the number is scheduled to double again in the 1990s. This increase has meant that the United States has, in relative terms, the largest prison population in the world.

The recently mounted War on Drugs has had little positive effect. Specialists note that the prevalence of drug abuse depends largely on social factors, not on law enforcement. The costs of maintaining an enormous prison population, most often young men in their late teens and early twenties, will come to appear too expensive and ineffective to be continued. The now radical approach of legalizing many drugs now illicit and spending money on sound education about the dangers of drugs and on rehabilitation of addicts, will, in the view of some specialists, come to be seen over the course of the next few years as the most efficient way of dealing with the drug problem. These specialists contend that this solution will be accepted because traditional methods failed, and consumed too much in the way of human and material resources. If these specialists are correct, in the next century drug addiction will come to be treated much as alcoholism is today, and most American's will view the War on Drugs much as they now judge the 1920s' experiment with Prohibition.

Rapidly growing pension and health care costs, already a serious public issue, will be even more burdensome in the next century. The aging of American society gives this issue an actuality that

increases daily. Finding fair and efficient means for dealing with it will mean making choices that will shape American society for years to come. Because choices made imply options closed off, the management of the issue has become a significant change driver for American society.

### Pensions

Baby Boomers will begin to retire early in the new century. The so-called dependency ratio, the ratio of workers to non-workers, will gradually worsen. A diminishing work force will have to pay for an increasing number of retirees. In the 1980s, worry about the long-term health of the Social Security system led to reform; for example, the long-standing retirement age of 65 was increased to 67, beginning early in the next century. In the future, retirement age will probably be moved back even more, to 70 perhaps. The change is a logical one, for improved health among the nation's population means that old age starts later now than it did in the past. A male who retired in 1940 at age 65, for example, could expect to live for 7 years after his retirement, compared to 10 years in 1970 and 15 years in 1990.

Early retirement will become less common in the next century, for studies show that retirement at age 60 can cost a pension fund two times more than one begun at 67. Part-time work by the elderly will become more common. Use of older people on a part-time basis has already proved very economical. Part-time workers, for example, have been found to produce more on an hourly basis than full-time workers.

The military will also be touched by these trends. As military pensions (or "retirement pay") come to consume an ever larger share of the nation's resources, their generous provisions will probably be cut back and retirement after 20 years of service may no longer be allowed. Today's healthier population means that 40- and 50-year olds are generally quite fit, able to sustain themselves even in hard conditions. This fact will be reflected in how long career personnel serve. If a completely professional military becomes too expensive, it may be replaced by a model common in Europe. This model has a small professional cadre that serves through age 50, and then retires on a pension or shifts to employment elsewhere; a larger highly trained group that serves long-term enlistments, but leaves the service without pensions; and many draftees who serve a year or two, then enter an active or inactive reserve. No European nation has been able to afford a military retirement system like that of the United States, and this country, no longer incomparably wealthy as it was in the first decade or two after World War II, may be obliged to follow Europe's method of managing military pensions.

Pensions will present another problem: pension portability, that is, how to maintain an already existing pension plan with a new employer. The information/service economy will mean that employees will often change jobs, making pension portability of crucial importance. Federal employees have long been able to take their pensions with them if they stay within the federal work force and reforms in the 1980s have broadened their options regarding pension portability. Retired military personnel can also attach their military career to time spent in government service for pension purposes. This right lessens

the financial burden of allowing soldiers to retire with a pension after twenty years of military service. Eventually, military pensions also could be made applicable to the private sector. For many workers in the private sector, however, solutions are only gradually being worked out.

Pension plans will become even more important for wage-earners in the future because declining average incomes have meant that fewer Americans are able to prepare for their old age through personal savings. But ways will have to be found to pay for these pensions. The Social Security payroll tax is already a serious burden for ordinary wage-earners. Plans to reduce or increase this tax can have political effects so vast and unforeseeable, that politicians from the president down fear for their careers when they have to deal with the issue. Choices will have to be made, however, and these choices will have to be both effective and enjoy the support of the electorate. If the choices are not seen as fair, ordinary people will not support them. If choices are not wise, retirement costs could become so great that they will damage the economy. Young workers could refuse to pay them, and businesses will not be able both to meet them and remain competitive internationally.

### Health Care

An aging population will need more care. Medical care, in turn, is becoming increasingly expensive; many specialists in medical care see the present American system nearing the crisis stage. Costs rose so much during the 1980s that only wealthy Americans need not worry about the devastating effects of catastrophic illnesses that can quickly wipe out a lifetime of careful saving. At the beginning of the 1990s, only about 10 percent of Americans were basically satisfied with their system of health care; 60 percent thought that it needed fundamental changes, and 29 percent believed it needed to be completely rebuilt. It is not only ordinary Americans who are threatened by high costs; many leading corporations contend they can no longer pay for their employees' health care and remain competitive in the global economy. Many poorer Americans, those outside the economic mainstream, have no access to medical insurance at all and must rely on Medicaid, a program said by some specialists to be headed for bankruptcy in a few years. Medicare, established for older Americans, appears on a sounder footing, but in coming decades will consume ever more of the federal budget.

Devising means to provide adequate medical care to all Americans while controlling costs will be one of the most important political issues of the coming decade. The debate will have an ethical component as well, for the country will probably have to weigh rationing medical care, not only to the elderly, but to the population at large. Choices will be made about the costs, both ethical and material, of allocating great resources for so-called "heroic" measures to extend the lives of the terminally ill and aged. Should money formerly spent on such measures instead go for a universal system of extensive prenatal care, for example?

The problems of rising costs, inadequate care for many, an increasingly aged society ever more in need of medical care, and the increasing specialization of medicine brought about by scientific advances have led some observers to foresee a more comprehensive system that will make medical care available

for all. Given America's individualistic traditions, and the lobbying power of the health insurance industry, this system will not necessarily resemble European national health plans, but is more likely to be set up by individual states and combine universal guarantees of health care with the resources of existing private health plans.

The social and financial costs connected with large numbers of people without sufficient medical care will be the change driver for this development. It will be seen that overall medical costs can be reduced by an increased emphasis on preventive care. An extensive pre- and postnatal program for all mothers will mean lower social expenditures of a corrective nature in the long run. A greater knowledge of what constitutes health, rather than a concentration on illnesses, will make for a healthier population. Many companies will reward employees who have health-enhancing habits; such an approach will also benefit American society. Health care for the elderly will, to some extent, be rationed. The overall needs of society will outweigh those of the old, whose medical care in the last few months of their life can consume medical resources that would otherwise benefit many younger persons.

Specialists foresee a smaller number of hospitals and an increased number of clinics offering ambulatory care. The first of these small facilities appeared only in the 1970s. By 1990 there were many thousands of them, and their numbers will grow in the future. These clinics have the advantage of easy accessibility for the public and are relatively inexpensive to operate because they are not equipped with very expensive and specialized high-tech equipment. Medical technology of this kind will be located in large regional hospitals that can treat illnesses beyond the capacity of clinics. Most of these hospitals will be owned and operated by a few large national firms. Independent, locally owned institutions will largely be a thing of the past. Specialists also predict that in the next century most American doctors will be salaried personnel, working for the few large health-care organizations.

### Values

Many observers see trends and social phenomena that point toward an increasingly tolerant and pluralistic society in the America of the next century. However morally abhorrent or distasteful some behavior may be to most people, if no definite moral or physical harm can be proven, there seems to be an increasing likelihood that it will be permitted. To a degree unparalleled in world history, laws are now in place protecting behavior that in the recent past would have been quickly repressed or hidden behind the veil of hypocrisy.

Even the political influence of the Moral Majority movement in the first half of the 1980s, could not prevent the rise of tolerance. Many Baby Boomers adopted the economic laissez-faire politics of the Reagan administration, but these same conservative Baby Boomers also applied this live-and-let-live philosophy to the private lives of others. Early in the second half of the 1980s the Moral Majority withdrew from the political arena and disbanded itself.

The revolution in telecommunications taking place the last few decades has affected values. Only the most secluded American can escape being confronted at every turn by different ways of living

and different attitudes about values. Americans outside of even the smallest town soon learn that anyone they may meet may hold opinions about morality, politics, and aesthetics that are very different from their own. This fact means that polite tolerance soon becomes a necessity if people are going to deal with each other on a day-to-day basis. This co-existence with others of radically different mindsets gradually brings about the ability to appreciate a multiplicity of views. It also brings with it the realization that when there are radically different views about the solution of common problems, creative methods must be devised to find mutually satisfactory solutions. The constant and increasing exposure of Americans to differing belief systems, is causing more time to be spent on learning conflict-resolution techniques, even at the grade-school level. To a greater degree than now, Americans of the next century will be skilled at dealing with a wide range of values. Provinciality may well become a thing of the past.[18]

The increasingly complex and interconnected society of the next century is likely to engender a new concern for the welfare of all citizens. It may become clearer than ever before that the misfortunes of individuals or particular groups hinder the progress of society as a whole. A feeling of shared destiny may become the hallmark of American society. Environmental concerns will contribute to this. The damage done to the environment in earlier, less informed times, will be obvious, and the common efforts and sacrifices needed to repair it and to prevent additional harm to our common natural world, will serve to heighten concern for the welfare of society as a whole.

If it does prove to be the case that the age of superpower rivalry is past, then the United States is not likely to need as large a military establishment in the future as it has in the past. The existence of a smaller professional armed force is not assured, however, for economic conditions may make such a force too expensive. For this reason it may be necessary to reinstitute a draft system. A universal draft, possibly registering women as well as men, would not be seen as fair, however, for given the large size of age cohorts in this country, most young people would not be inducted into military service. For these reasons, it might prove useful to establish a new form of national service, one with both military and civilian components. Young people could be called up for two years and allowed to decide where they would serve. Social work, rehabilitation of the environment, or service in a small armed forces could be among the options. Given the fact that most youths would not be soldiers, physical and mental requirements could be set at such a level that virtually all young people, males and females, even the disabled and mildly retarded, would be involved. The term of service could be inexpensive, would provide the country with a directed work force to deal with problems of all varieties, would mix young people of all classes and races, help inculcate common values, and would tap the wells of idealism typically a characteristic of youth. [35]

### Religion

American society has always been markedly religious. There is no reason to believe that religion will not remain vitally important to many Americans in the next century, but is likely to differ from today in that many smaller churches will have appeared, and some "faiths," like the New Age

movement, only loosely defined as religions, may be widespread. During the 1980s, the older established churches lost members. In order to retain their membership, they frequently relaxed their stands on religious doctrine or social issues, or they gave way to more radical groups within their membership. Part of the established churches' greater liberality was a reflection of a more tolerant mainstream America. The tensions that shifting values can call forth within church organizations was especially noticeable within the Roman Catholic church. Since the hierarchy remained quite conservative during the long papacy of John Paul II and did moderate its doctrinal positions, many of the lower clergy paid only lip service to their church's stands. In private they counselled their flock to follow their own conscience.

In recent years mainstream religions have been the source of much opposition to the use of U.S. armed forces abroad. This trend is likely to increase in the future, as mainstream religions become more dominated by people born after World War II and who therefore have never experienced a long and difficult, but popularly supported, military intervention abroad. The continued presence of this opposition movement in the churches is likely to be less important in the future because wars are likely to be short, or involve few troops, or if these conditions are not possible, will not be waged unless wide public support is certain.

Fundamentalist religions will continue to play a role in society, perhaps much as they do today, but this role will continue be a secondary one, highly visible, but not dominant. The political influence fundamentalism enjoyed in the early 1980s through the Moral Majority movement is unlikely to be repeated in a increasingly tolerant America. Legal initiatives sponsored by fundamentalists are likely to be occasionally successful on a local or state level but be struck down by higher courts if they abridge the rights of others. The traditionally fervent patriotism of fundamentalism may well be tempered by the increasing complexity and interconnectedness of the world.

America is still overwhelmingly Christian, but not to the degree it was formerly. In addition to the long-established Jewish population, most of whose forebears arrived in this country before World War I, there has been a more recent influx of Muslims, although many Americans of Arabic extraction are Christian. In the last few decades many immigrants have come from India and Asia and an estimated one million Buddhists now live in the United States. This multiplicity of old and established religions will also likely lessen the influence of fundamentalism in the future.

America has a long history of do-it-yourself religions, and this tradition will continue unabated into the new century. People will fashion religions of their choosing. As before, there will be religions that preach "feel good" messages and garner large, if not solid, followings. Some of the new faiths will not be Christian, but assemble a worldview out of anything handy. In the 1980s, the "New Age" religion (or is it a life style?) attracted a good deal of attention. With little mental or moral strain, but with some financial sacrifice, this faith offers its followers advice, contentment, physical health, and even spiritual, or spiritualistic, excitement. This particular sect and others like it may fade away before the new century arrives, but similar "faiths" or "modes" will likely replace it.

## Lifestyles

Americans will live somewhat differently in the next century, although changes will be of degree, rather than kind. The trend away from the classic nuclear family is likely to continue (the results of this trend have been sketched out in an earlier section). The most striking changes in how Americans live, and perhaps the most painful, will be connected with changes in the ways they earn their living.

The trend toward the new interconnected real-time global information/service economy will force firms to adapt to changing business conditions. The new conditions will mean constantly evolving job requirements and a highly flexible work force. Workers will change jobs often. An increasing number of workers will be hired via short- or long-term contracts. Once contracts are completed, workers will have to secure new ones to earn their livelihood. Companies will become smaller. The enormous factories that have dominated the manufacturing sector since the early Industrial Revolution will give way to many smaller firms located in industrial parks. Workplaces of this nature are easily opened and just as quickly shut down, making for much employment insecurity.

These trends will affect where people live. The old urban centers will continue to lose population, while a network of small population clusters will spring up beyond the suburbs built in the post-war era. Commuting will more often than not be between these new rural/suburban centers, rather than involve a long trek into the core city. The distinction between rural and urban will lose much of its importance and be replaced by this mix of urban, suburban, and satellite areas.

As much of the work of the new century will be done on computers that can easily be connected to one another and to a corporate headquarters, more Americans will probably be working at home. The expected increase in the number of self-employed and contract employees will also favor this trend and likewise permit more part-time work, more flexible schedules, and make job-sharing more common. The trek of large numbers of employees to and from their workplace at the sound of a whistle will be an anachronism.

An unfortunate consequence of this ever-widening and thinning web of habitation will be the continued decay of the old urban centers and the isolation of minority groups living in them, trends already well established today. Innovative social policies might alleviate the problems of inner cities, but their implementation may be difficult in the harsher economic conditions of the next century.

This study assumes that the trend toward an increasingly tolerant America will continue. As a result of trend, minority groups will have a greater feeling of self-worth and increasingly come to celebrate their heritages. Their numbers, the economic success of a good part of their members, and their greater self-confidence may mean that in regions where they predominate, their cultures will flourish. Examples of this today are the highly successful Asian-American communities of California.

As the time approaches when whites become one minority among many (estimated by some to occur around the middle of the next century), the country may come to consist of regions where one or several minorities predominate, each with its unique flavor. The United States could become, in effect, the United Peoples of America. A potential disruptive aspect of this trend is that it could increase

regionalization and might make framing nation-wide policies more difficult than it is today.

Retirees are another social group that may come to impose their character upon certain regions of the country. Large numbers of the able-bodied retired may also come to dominate in more areas than at present; currently only Florida and Arizona have socially significant numbers of retirees. These older people, relatively affluent, will change the areas in which they live by the way they spend their time and money and by their social and political concerns.

A number of major American corporations are already preparing for the large market of older people who will want to live in retirement communities. This trend will continue, even though retirement specialists have found that most retirees remain in the towns in which they spent their working lives. A new development in this housing market, however, will be the construction of centers for older Americans who can no longer completely manage their own care. Until their mid-seventies, most older people are self-sufficient; thereafter, they become ever more dependent on the care of others. Some large corporations are already planning to meet the needs of this population group.

Many older people will be well-provided with housing, however, even having more than they need. Many will sell their large homes, acquired when they were raising their families, for something smaller. Many will remain where they are and perhaps divide their homes into several smaller households. Younger people will likely find housing costs often beyond their means, so a sharing of a house with some older people, perhaps their parents, is seen by specialists as likely to become more common in the future. An Australian housing variant, the so-called "granny shack," that is, a smaller dwelling next to the family house to which older people might move after their grown children start their own families, is also seen as a likely trend in the future.

Retirees will often be "house-rich" and "cash-poor." A likely response to this situation will be so-called reversed mortgages, by which older people pledge their house to a financial organization, to be ceded upon death, in exchange for ready capital. Variants of the device are being worked out already and will become common in the next century.

## POLITICS

If the Cold War does come to an end in the early 1990s and, as a result, the United States is not involved in any serious large-scale conflicts, then American politics in the next decades will likely center on domestic issues. The portion of the budget going to defense will decline, with funds instead going for domestic purposes. It is likely, however, that the most important domestic political issue will be, in essence, international: namely, what political measures will be undertaken to ensure that the United States is competitive in the global economy. In short, the great change driver in American politics in the coming decades will be how this country deals with the trend towards an interconnected world market. Choices will be made about how much government intervention in economic affairs is permissible and advisable, how to ameliorate social ills that consume material and human resources, how to train and educate Americans to prosper in the new economy, how to improve the country's infrastructure, and how

to best manage the aging of America, to name only one of this country's most pressing future concerns.

If, for reasons outlined above, the United States becomes a more tolerant country, then racial or ethnic tensions will be less a generation hence than they are today. On the other hand, economic trends are likely to strengthen tensions stemming from economic or class differences. Public disorders growing out of these tensions could be an ever-present danger if many Americans feel they have not had fair economic opportunities. In that case, resources would have to be allotted to deal with these potential outbreaks of violence and, as in many other countries, the military may have to concern itself with domestic threats as well as external ones.

Political parties will continue to play key roles in politics but they are likely to be less important than they are today and function to a greater degree than today as frameworks in which individual politicians pursue their own objectives. Party discipline has always been weak in American politics. Because the United States has shunned the principle of proportional representation, making it extremely difficult for small parties to achieve a political foothold, American parties are to some degree coalitions, often with members who are ideologically opposed to one another. This lack of coherence in political parties will increase as problems become increasingly serious. Innovative members of both parties will respond creatively to these problems, often forming coalitions with members of opposing parties to achieve results. Coalition formation is likely to become an even stronger trend in the future as traditional America gradually fades away, to be replaced by something new.

The coalition built by Roosevelt may largely disappear in the coming decades. The south is already no longer solidly Democratic, the unions and their membership will be fragmented and diminished, and minority voters are more likely to approve policies that match their individual place in the economy or society than to vote in a racial bloc. Republicans will also have few certain voting blocks. If the south will no longer be controlled by the Democratic Party, it will not be tied completely to the GOP either. The midwest farm vote will have vanished with the passing of the small farm, and agribusiness, while rich, will not control many votes. The millions of white collar and new collar workers, that is workers in lower level service jobs, will be a fickle group, largely unpredictable in their voting habits. Also unpredictable will be the many new entrepreneurs that will emerge in the new information/service society. Global in outlook out of necessity and pro-business because of their occupations, they will be liberal or at least tolerant in their social attitudes. A relatively peaceful world and a reconfigured Soviet Union will make anti-communism seem quaint to them. Older Americans will, of course, be a sizeable group in society. They will have the highest percentage of voters and a number of strong concerns, notably pensions and health care, but their attitudes on many issues are likely to vary just as much as they do in other age groups.

Given the economic rigors of the coming decades, some political analysts believe that in the future, American parties, or at least segments of them, will adopt more pragmatic positions on social and economic issues. The left/right clashes of earlier decades will seem less relevant in the new century, and the overriding importance of a smoothly functioning economy may submerge other issues, or cause them to be handled differently. For example, affirmative action may be gradually displaced by a policy of

creating opportunities for everyone. The need for almost everyone to be continuously retrained will mean the establishment of education programs that will address the needs of all citizens, not just disadvantaged groups and the young. The fact that nearly all Americans will feel the cool winds of the new global economy, that all wage-earners, skilled and unskilled alike, will know economic insecurity may make many former concerns seem parochial and allow new feelings of solidarity across the nation as a whole. [39]

### Generations at odds

Given the continuance of existing trends, it is possible that disputes between generations about how the country's resources should be allocated will be at the forefront of domestic politics in the first decades of the next century. The prime concerns of older Americans will be their pensions and their health and nursing care. Younger Americans will be concerned about the economy, their standard of living, their prospects for the future, and the education of themselves and their children.

The largest lobbying group in the United States in 1991 is the American Association of Retired Persons. One of its publications, Modern Maturity, has a larger readership than either Reader's Digest or TV Guide. Older people are organized, are the most likely to vote (see Fig. 2), and have more people their own age in Congress than any other group. Although older people have good reasons for their demands and entitlements, it is possible that younger people will come to believe that the old take too much of the country's finite resources. The ever-worsening U.S. dependency ratio will make meeting the elderly's demands increasingly difficult for the working population.

Disputes between the generations could come to have a racial or ethnic component. For the coming decades at least, most of older America will be white. It could eventually be the case that an older White America, while willing to pay taxes for the benefit of its own children, will not be willing to apply resources for the education of increasing numbers of Hispanic, Asian, and black children.

## VOTER TURNOUT RATES BY AGE COHORT: 1964 TO 1988

PERCENT VOTING

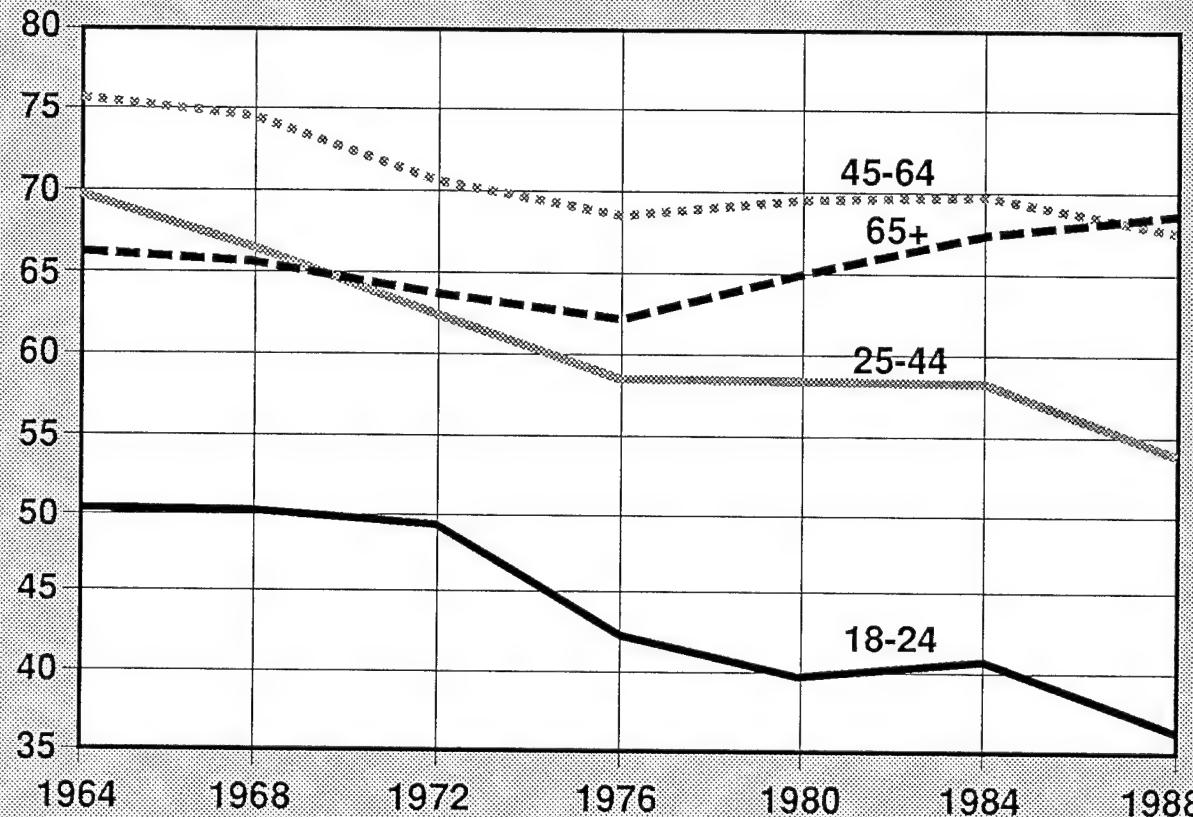


Fig. 2

## **Regional and Interest Politics**

It is reasonable to assume that politics on a subnational level will come to be more important in the next century. The complexity of the tasks that political bodies will confront might be more manageable if town, state, and regional governments, rather than the national government, deal with them. For this reason, new governing mechanisms are likely to be developed, or, at the very least, existing governing bodies will be improved, to deal with public issues in the coming decades.

In its effort to develop a more efficient and dynamic society, the American people will devise new bodies to govern the vast metropolitan areas that already cut across municipal, county, and state boundaries. Greater Los Angeles has an economy that in size exceeds that of many nations. The Baltimore-Washington area will be ever more closely interconnected in the next century. Greater New York will extend ever further outward from Manhattan. The vast urbanized region extending from Boston to Washington (BosWash) already contains one-sixth of the nation's population on 2.1 percent of its land, and by 2015 will contain an even larger share of this country's people, packed ever more densely together. A counter trend to this increasing concentration in certain areas, generally along the nation's coasts, will be an emptying out of other regions, most notably the rural areas of the midwest where many small towns are already in the process of disappearing.

Creating new mechanisms to govern these collections of human beings will take much political energy. Entrenched politicians will not want to cede power to larger, overarching entities. Inner-city politicians will not be eager to share power with suburban leaders, who, in turn, will not want to saddle their districts with the expensive problems of the core city. Governing entities will be developed to deal with the problems and goals of the larger regions. Business, social, and environmental concerns of these regions will be managed by new regional governing bodies that will have the power to overrule traditional political bodies. [15]

How far this political reformation will extend is uncertain. The division of the United States into fifty states is no longer particularly efficient. Getting extremely diverse states to agree on common policies is frequently impossible. Arizona has little in common with New Hampshire, other than both are parts of the United States. States are frequently divided against themselves. Flat eastern Colorado has very different concerns than mountainous western Colorado. Northern Virginia is part of BosWash, unlike the state's tobacco-growing counties.

Forced by the international economy to manage its resources better, the United States will experiment with alternative ways of governing itself. Perhaps some kind of Regional Congress will be devised, one that has only advisory powers but is able to lobby foreign firms for investments. This Regional Congress could be the site where regional parties, that is, parties bound together by common concerns and shared values and attitudes, would be active.

This possibility is not as farfetched as it might first appear. For example, one student of this country, the journalist Joel Garreau, divides the United States into nine nations (see Fig. 3). He includes in this construction large parts of Canada, Mexico, and the Caribbean. He sees North America as

consisting of New England and its extension into Canada; Quebec; the Foundry, often frequently referred to as the Rust Bowl; the Breadbasket (central Canada, much of the midwest, and northern Texas); Dixie (including the eastern third of Texas and northern Florida); the Islands (southern Florida and the Caribbean islands); Mexamerica (western Texas, New Mexico, Arizona, southern California, and much of Mexico); the Empty Quarter (mountain states and the Rockies in Canada); and Ecotopia (northern California, Oregon, Washington, western Canada, and southern coast of Alaska). However crude Garreau's design, it conforms much more closely to social and economic realities than does the current political delineation of North America.

Some regions will be more successful than others in the new century. Silicon Valley, the Minneapolis-Saint Paul area, and greater Washington are likely to fare better than the urban centers of the Rust Belt. It is conceivable that successful areas, having much in common, might join together to lobby governing bodies for their purposes. With great financial resources and the best brains money can buy at their disposal, a so-called High-Tech/Service Association would have much success in forwarding its interests. These areas, well connected to the global economy, could have very different domestic and foreign agendas than areas not prospering in the next century.

Will prosperous regions be willing to help poorer regions? Will there be there be a national agency that steers "seed money" to areas in distress? In the Brave New World of the coming century, will there be a feeling that all Americans are in the same boat, or will a philosophy of Social Darwinism determine public policy? These are issues that will set public debate in the next century.

Television transformed American politics in just a few decades. The 1948 presidential campaign is said to have been the last in which television played no part. The computer information network already in existence is certain to expand in the next 25 years and create what could be called a microelectronic society in which large segments of the population will be "in touch" electronically with the larger world. For example, interest groups of all stripes will carefully monitor government and business decisions affecting them via large data banks earmarked to their specifications. Apprised of a happening that affected it, an interest group will inform its members and take appropriate action. This ability of immediate response to even the slightest of events, will, in effect, give America a "hair trigger" democracy. [6]

Interest groups, by their very nature, agitate for their narrow advantage, often at the cost of the common good. The increased strength of well-positioned groups in the new century might be countered, according to a suggestion of Robert Dahl of Yale University, by a randomly selected number of citizens, perhaps a thousand adults from all walks of life, who would in effect be an "amateur congress" that would debate issues. By means of computer information networks, this group could be furnished with data needed for decisions on contentious issues, and study, reflect, and finally decide in an electronic town meeting. Final judgements could be passed on to the appropriate level of government, local, state, and national. If this citizens' congress did its work well, its findings might have considerable weight. [8]

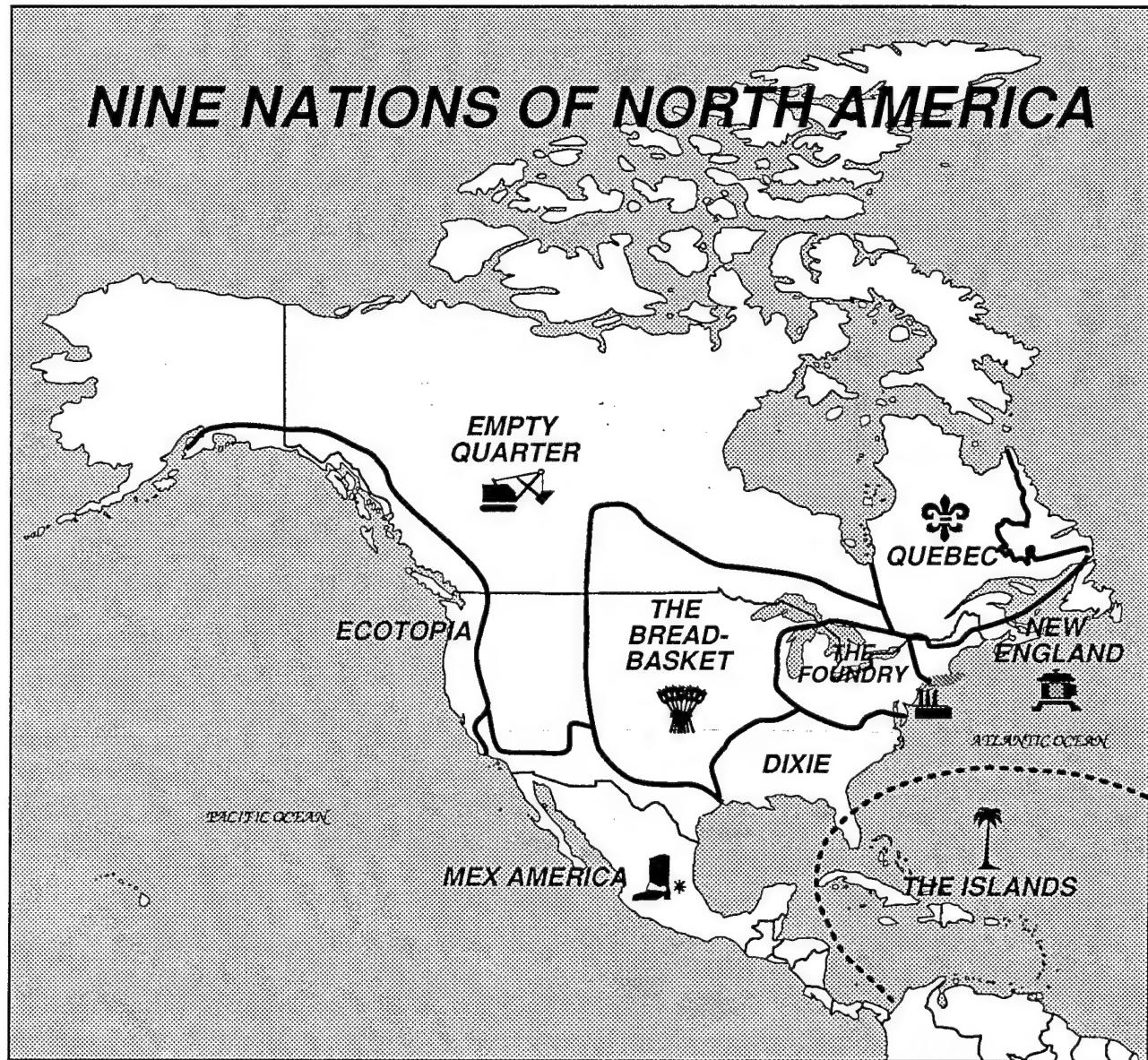


Fig. 3

## CONCLUSION

The past 25 years have seen numerous events that have changed how people live. Oil-price shocks, Japanese economic ascendancy, the mass distribution of home computers and video, Germany's unification, the moonlanding, the women's movement, the invention of the compact disc and fax machine, the disappearance of the Warsaw Pact, live television broadcasts around the globe via satellite, the Third World's "defeat" of the superpowers in Vietnam and Afghanistan are only a few of the developments of this period that have altered the world in which we live. There is no reason to expect that the next 25 years will not witness equally striking events.

The challenge posed to the United States by the ever more interconnected global economy will cause great wrenching changes in the next decades. The world of 2015 will be a very different world from today's, as will the role the United States will play in it. The largely bi-polar world that existed for a few decades after World War II will have given way to a multi-polar world with a variety of complex political, economic, and strategic relationships. American society, largely impervious to developments outside its borders during much of the post-war period, will be increasingly tied to the rest of the world, and the lives of people in small towns in the Midwest or Appalachia will be affected by business choices made in Europe or Asia.

The growing interconnectedness of the world will be the great change driver in the next decades. Its effects will alter American society decisively, not always in welcome ways. Ordinary Americans may have to accept a lower standard of living as other countries take more of the world's wealth. The rigors of the global economy will mean the extinction of some segments of the U.S. economy, while other branches will be successful and grow in strength. Parts of the United States will prosper, while some regions will be devastated unless far-sighted industrial policies are in place.

Efforts to improve U.S. competitiveness will mean a substantial channelling of resources to education and probably expanding its scope to cover not only the formative years but a person's whole working life. Maintaining the nation's physical infrastructure will require more attention if the country is to compete successfully. In addition, an aging population will take ever more of the nation's wealth, perhaps at a catastrophic rate after 2015. Unless the U.S. economy improves significantly and provides employment for everyone, or bold and effective social measures are devised, this country's already large underclass may well grow further and consume much resources via inadequate welfare and penal systems. Environmental concerns will also require much of the country's resources and, in addition, will lead to a greater regulation of how people live and work.

Dealing successfully with these trends will require policy choices of broad impact. These choices could exacerbate existing social tensions and engender a society of hostile and mutually destructive groups. The unresolved struggles between narrow interests, whether regional, class, minority, or generational, could come to dominate political life, as could the politics of resentment if, as is likely, the economy worsens and no overarching positive solution to the country's problems is found.

The nation's military establishment will be affected in the difficult years during which the United States seeks to come to terms with the highly competitive global economy. It will probably have to accept a smaller share of the country's resources than it has in the past. The likely waning of the Cold War should make this feasible; a smaller military could still guarantee the country's security in a world where armed conflict was likely to be waged on a limited scale. The military is likely to be only slightly affected by social tensions that may appear in an era of declining living standards and painful economic choices. In recent decades, moreover, the U.S. military has shown that it can create within itself a society marked by equality and one that is, to a greater degree than is the case in the society at large, free of racial and political unrest. In addition, the economic uncertainty experienced by the country at large will make a military career attractive to talented youth from all social groups.

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## KEY JUDGMENTS TECHNOLOGY

— When technology is considered, it is not enough to focus on generations of hardware platforms (for example, tanks, airplanes). To understand the state-of-the-art and project future potential of technological developments, it is necessary to view technology in the context of four related concepts: hardware, process, system, and environment.

— Identification of key areas of current and potential future progress cannot be made by short lists of general categories. It must be done by pinpointing the very specific areas (which are very many) where progress is actually occurring. The Nasa Thesaurus (NASA SP-7064), containing many thousands of listings, can be adapted as a general guide, and areas of progress correlated to those listings with new items added as necessary using the same generation rules as NASA.

— The search for potentially useful (or critical) new developments should be pursued in two directions--from general scientific developments worldwide, and from the point of view of which components of Army equipment currently in use or in development can be improved (for example, better sensors, better interfaces, better effectors, etc.).

— Technology comes from science, is developed and financed by industry, proliferates through mass production, and feeds back to science in financing the search for continuing improvements, and in providing science with better tools for research.

— We are currently in a period where some developments in science and technology are undergoing astoundingly rapid change with no immediate limits, while other developments are "bumping up" against limitations of physical reality.

— The military plays a key role in supporting developments in science and technology. Efficiency can be added by knowledgeable selection of areas to support, with de-emphasis of some popular areas in which the industry at large is already heavily involved and is doing a sufficient job. Increased emphasis could be focused on "orphan technologies" that are not currently popular but which could yield significant return for a small investment, research areas that are too expensive for individual companies, and areas of basic research that require not much more than support funds for individual researchers.

— The military can play a highly significant role in developing education and training technology for itself and for the United States.

— Technology intelligently used is the single most important consideration for a functional Army of the future.

## TECHNOLOGY

### INTRODUCTION

#### Definition

The term "technology" comprises a rough hierarchy of four related concepts:

1. technology as hardware, e.g. a tank;
2. technology as process, e.g. the process for manufacture of optical fiber;
3. technology as system, e.g. transportation system;
4. technology as environment - the technological milieu of operations - the general availability of a particular caliber of munitions, for instance, or a weapon, such as the Kalashnikov rifle; the availability of electrical power networks to recharge batteries; the availability of cheap and reliable Japanese microchips for use in advanced weapons systems in Desert Storm, etc. The American officer in Grenada who used his AT&T credit card to call for air support when the regular military channels were not available used his technological environment to good advantage.

Awareness of the four aspects of technology above is necessary to understanding any technology application. No rigid boundaries between the concepts are necessary, and the way the term "technology" is used is then clear from the context. Confusion arises only when the categories are mixed without awareness of descriptive level and when an attempt is made (usually unconscious) to limit the term "technology" to a narrower sense, excluding the other aspects.

#### Reinventing the Camel

A camel, some wag has suggested, is a horse put together by a committee. For some reason--probably involving the perceived need to focus research funds--the public is being inundated by committee-produced lists of "technologies" claiming to provide comprehensive coverage of developments relevant to particular constituencies. These include a list of 15 items issued by the United States Department of Commerce (Emerging Technologies: A Survey of Technical and Economic Opportunities, Spring 1990):

advanced materials, advanced semiconductor devices, superconductors, flexible computer integrated manufacturing, artificial intelligence, high-performance computing, advanced semiconductor devices, optoelectronics, digital imaging, sensor technology, high-density data storage, biotechnology, medical devices and diagnostics,

and a list of 22 items issued by the United States Department of Defense (Critical Technologies Plan, 15 March 1990):

composite materials, semiconductor materials and microelectronic circuits, superconductors, machine intelligence and robotics, software producibility, photonics, parallel computer architectures, data fusion, signal processing, passive sensors, sensitive radars, simulation and modeling, computational fluid dynamics, biotechnology materials and processes, air-breathing propulsion, high energy density materials, hypervelocity projectiles, pulsed power, signature control, weapon system environment.

The Army has its own list of 13 "Key Emerging Technologies" (Army Technology Base Master Plan, 2d ed., November 1990):

advanced propulsion, advanced signal processing and computing, artificial intelligence, biotechnology, low observables, micro-electronics/photonics/acoustics, neuroscience, power generation/storage/conditioning, protection/lethality, robotics, space technology, advanced materials/materials processing,

and, to cap it all, The White House's distinguished National Critical Technologies Panel of 13 luminaries (that leaves just 987 points of light elsewhere in the nation) has just issued an annotated list of 22 "National Critical Technologies" (Report of the National Critical Technologies Panel, March 1991):

MATERIALS - materials synthesis and processing, electronic and photonic materials, ceramics, composites, high-performance metals and alloys,

MANUFACTURING - flexible computer integrated manufacturing, intelligent processing equipment, macro- and nanofabrication, systems management technologies,

INFORMATION AND COMMUNICATIONS - software, microelectronics and optoelectronics, high-performance computing and networking, high-definition imaging and displays, sensors and signal processing, data storage and peripherals, computer simulation and modeling,

BIOTECHNOLOGY AND LIFE SCIENCES - applied molecular biology, medical technology, AERONAUTICS AND SURFACE TRANSPORTATION - aeronautics, surface transportation technologies,

ENERGY AND ENVIRONMENT - energy technologies, pollution minimization, remediation, and waste management.

**TABLE 1**  
**ARMY KEY EMERGING TECHNOLOGIES**

NATIONAL CRITICAL TECHNOLOGIES	COMMERCE EMERGING TECHNOLOGIES	DEFENSE CRITICAL TECHNOLOGIES	ARMY KEY EMERGING TECHNOLOGIES
<b>MATERIALS</b> <ul style="list-style-type: none"> <li>- Materials synthesis and processing</li> <li>- Electronic &amp; photonic materials</li> <li>- Ceramics</li> <li>- Composites</li> <li>- High-performance metals &amp; alloys</li> </ul>	<ul style="list-style-type: none"> <li>- Advanced materials</li> <li>- Advanced semiconductor devices</li> <li>- Superconductors</li> </ul>	<ul style="list-style-type: none"> <li>- Composite materials</li> <li>- Semiconductor materials and devices</li> <li>- Superconductors</li> </ul>	<ul style="list-style-type: none"> <li>- Advanced materials/material processing</li> </ul>
<b>MANUFACTURING</b> <ul style="list-style-type: none"> <li>- Flexible computer-integrated manufacturing</li> <li>- Intelligent processing eqpt</li> <li>- Micro- and nanofabrication</li> <li>- Systems mgmt technologies</li> </ul>	<ul style="list-style-type: none"> <li>- Flexible computer-integrated manufacturing</li> <li>- Artificial intelligence</li> </ul>	<ul style="list-style-type: none"> <li>- Machine intelligence and robotics</li> </ul>	<ul style="list-style-type: none"> <li>- Neuroscience technology</li> <li>- Artificial intelligence</li> <li>- Robotics</li> </ul>
<b>INFORMATION &amp; COMMUNICATIONS</b> <ul style="list-style-type: none"> <li>- Software</li> <li>- Microelectronics &amp; optoelectronics</li> <li>- High-performance computing &amp; networking</li> <li>- High-definition imaging &amp; displays</li> <li>- Sensors &amp; signal processing</li> <li>- Data storage and peripherals</li> <li>- Computer simulation &amp; modeling</li> </ul>	<ul style="list-style-type: none"> <li>- High-performance computing</li> <li>- Advanced semiconductor devices</li> <li>- Optoelectronics</li> <li>- Digital imaging</li> <li>- Sensor technology</li> <li>- High-density data storage</li> </ul>	<ul style="list-style-type: none"> <li>- Software producibility</li> <li>- Semiconductor materials and microelectronic circuits</li> <li>- Photonics</li> <li>- Parallel computer architectures</li> <li>- Data fusion</li> <li>- Signal processing</li> <li>- Passive sensors</li> <li>- Sensitive radars</li> <li>- Machine intelligence and robotics</li> <li>- Simulation &amp; modeling</li> <li>- Computational fluid dynamics</li> </ul>	<ul style="list-style-type: none"> <li>- Microelectronics/photonics/ acoustics</li> <li>- Advanced signal processing &amp; computing</li> </ul>
<b>BIOTECHNOLOGY &amp; LIFE SCIENCES</b> <ul style="list-style-type: none"> <li>- Applied molecular biology</li> <li>- Medical technology</li> </ul>	<ul style="list-style-type: none"> <li>- Biotechnology</li> <li>- Medical devices &amp; diagnostics</li> </ul>	<ul style="list-style-type: none"> <li>- Biotechnology materials &amp; processes</li> </ul>	<ul style="list-style-type: none"> <li>- Biotechnology</li> </ul>
<b>AERONAUTICS &amp; SURFACE TRANSPORTATION</b> <ul style="list-style-type: none"> <li>- Aeronautics</li> <li>- Surface transportation technologies</li> </ul>	<ul style="list-style-type: none"> <li>- Air-breathing propulsion</li> </ul>		<ul style="list-style-type: none"> <li>- Advanced propulsion</li> </ul>
<b>ENERGY &amp; ENVIRONMENT</b> <ul style="list-style-type: none"> <li>- Energy technologies</li> <li>- Pollution minimization, remediation &amp; waste mgmt</li> </ul>			<ul style="list-style-type: none"> <li>- Power generation, storage &amp; conditioning</li> </ul>
		<ul style="list-style-type: none"> <li>- High-energy-density matter</li> <li>- Hypervelocity projectiles</li> <li>- Pulsed power</li> <li>- Signature control</li> <li>- Weapon system environment</li> </ul>	<ul style="list-style-type: none"> <li>- Directed energy</li> <li>- Protection/lethality</li> <li>- Low observables</li> </ul>
			<ul style="list-style-type: none"> <li>- Space technology</li> </ul>

The lists are quite different. Despite the fact that two lists contain very similar or even identical categories, the other categories in the lists make it clear that they in fact include different subcategories. The Army list has the category "advanced materials/materials processing," while The White House compilation includes "materials synthesis and processing," and the Department of Commerce has "advanced materials," (DOD has "composite materials"). Sound similar? The White House list has separate categories for "ceramics," "composites," and for "high-performance metals and alloys," all of which, along with "advanced materials," are subcategories under "materials." The Department of Commerce has separate categories for "advanced materials" and "superconductors," (also a separate category in the DOD list). The Department of Defense has a joint category for "semiconductor materials and microelectronic circuits" that compounds the confusion.

The list makers are quite aware of each other's lists, and even try to provide category equivalence comparisons ("Table 2" in The White House list, for example). This Table, with the "Army Key Emerging Technologies" added, is shown as Fig. 1. The Army provides the most exhaustive "crosswalk" between its list and the DOD list (see Fig. 2), quite correctly matching its own "advanced materials/material processing" category with the following categories on the DOD list: "composite materials," "semiconductor materials and microelectronic circuits," "superconductors," "photonics," "passive sensors," "biotechnology materials and processes," "air-breathing propulsion," high-energy density materials," "hypervelocity projectiles," "pulsed power," and "signature control." Note the inclusion of biological materials as "advanced." (And why not?)

What is one to do with all of these "technologies?" One answer is to treat them as separate technologies. Some researchers have gone so far as simply to add the lists together and characterize each category as a separate "technology," listing its source/agent, potential use, milestones, and risk/feasibility factors. Aside from the questionable validity of assigning a single feasibility factor to advances in "microelectronics/photonics/acoustics," which is, in fact, not a single technology but a mixed category of many different technologies, the additive mixing of lists clearly introduces enormous redundancy and destroys all categorization.

Some large areas are omitted from each list. Only the Army had the political courage to include "space technology," for example. The White House Panel specifically and intentionally excludes manned space exploration, implying that it "does not enhance national security and economic competitiveness," a very questionable judgement in itself. Paradoxically, the panel equivocates that

space exploration will continue to stimulate a broad range of advances in both aerospace and non-aerospace industries, contributing to our ability to compete in the high-technology global marketplace. [10]

The Panel states that "there are other national goals not addressed in this report." Why not? Which areas of technological advancement (besides manned spaceflight) will not enhance national security and competitiveness? It omits fusion energy as too long-term, and "signature control" as "important but restricted." Oddly enough, though, in the description of the "materials" section, the very first desired

category includes "more 'stealthy' aircraft structures," an item that could certainly be termed "signature control." In the "Ceramics" section, it focuses on "military/aerospace" designs and specifically mentions the Space Shuttle tiles. Nothing is really omitted in the sense of one not being able to place a particular development in a category (unless one mentions the specifically excluded words "signature control" or "nuclear fusion"--they can be added under other categories).

Any one of the lists will suffice for a category breakdown (some lists better than others) if the category designations are considered just that--category designations in a comprehensive, all-encompassing scheme, into which one may insert critical advanced developments as they are identified now or in the future. In that sense, the real Key Emerging Technologies would be items like "advances in optical masking techniques below .5 micron line separation," not "microcircuit design," or "microelectronics," and certainly not "microelectronics/photonics/acoustics." The latter is quite acceptable as a general category, as long as the actual "emerging technology" items are specifically identified. This "specific identification" process should be the ongoing task of a competent group of research analysts within the Army in order to see where the advances lie.

Of course, a better general category scheme may well be possible for the next edition, designed as a categorization scheme rather than as a scheme designating whole large areas as "critical" while omitting decent categories for significant developments in areas that are not properly covered.

How should the categorization proceed? In two directions: equipment based and science-based. Any specific developments relevant to equipment described in the Army Technological Base Master Plan that would significantly improve the functionality, deployability, etc. of that equipment should be so identified. At that point developments in the technological environment or scientific research that suggest new equipment, new applications, new missions, or new developments in the potential "weapons environment" should also be identified. The list of "key technologies" should be quite large and constantly monitored for new developments, with items added and dropped constantly as the technological environment progresses.

DoD CRITICAL TECHNOLOGIES	ARMY KEY EMERGING TECHNOLOGIES											
	Advanced Materials/Material Processing	Advanced Signal Processing	Biotechnology	Artificial Intelligence and Computing	Directed Energy	Low Observable Technology	Micro-Electronics, Photonics, and Acoustics	Advanced Propulsion, Storage, and Conditioning	Robotics	Space Technology	Neuroscience Technology	Protection/Lethality
Semiconductor Materials and Microelectronic Circuits	●	●				●						
Software Producibility		●		●								
Parallel Computer Architectures	●		●			●				●		
Machine Intelligence/Robotics	●		●					●				
Simulation and Modeling	●	●	●	●		●			●		●	●
Photonics	●	●				●				●		
Sensitive Radars		●			●	●				●		
Passive Sensors	●	●			●	●	●			●	●	●
Signal Processing		●		●	●	●	●			●		
Signature Control	●	●				●	●		●			●
Weapon System Environment				●	●	●	●		●		●	●
Data Fusion		●		●		●		●		●	●	●
Computational Fluid Dynamics		●						●		●		●
Air-Breathing Propulsion	●				●			●				●
Pulsed Power	●				●		●			●		●
Hypervelocity Projectiles	●					●	●			●		●
High Energy Density Materials	●			●			●	●				●
Composite Materials	●		●				●	●	●	●		●
Superconductivity	●					●						
Biotechnology Materials and Processes	●		●							●		

Fig. 1

## **GENESIS OF TECHNOLOGY (THE SCI-TECH ENGINE)**

Technology is generated from science and resources. Science provides the knowledge that a particular development may be possible, whereupon someone who needs that development for enrichment or defense invests in the engineering needed to produce a technological product. The vindication of the scientific research through a successful product then leads to further investment in the science in the hope of producing more knowledge that can be used in the same way. Alternatively, the need for a particular product (e.g. AIDS vaccine), impels the application of resources to science in the hope of finding a knowledge framework from which the product can be developed by use of more resources. The term "resources" includes manpower (trained, staff and management), site, materials, training, etc., most of which can usually (though not always) be purchased through proper funding. The silent third partner in the enterprise (in addition to science and resources) is, of course, luck, since there are rarely any absolute guarantees that a particular effort will pay off.

Science is also funded for "pure knowledge" - the propensity of human beings to want to know about the nature of things - but the scientist, for all his (or her) protestations of purity, often drags out the carrot of "technological fallout" possibilities deriving from pure research as the reason for further funding. And not without cause, since in the final account there is no technological progress without prior progress in science, and one never knows when a mother lode of technological implications will be struck by an unsuspecting "pure" researcher.

Whatever one's view of the importance of pure science may be, the successful sales of developed products (to civilians or to governments) have been a critical driver - "force multiplier" for science and therefore, in turn, for technology as well, particularly for development of unforeseen technologies.

Another "force multiplier" for science has been the improvement of existing instruments and the development of new ones. It is here that technology provides direct feedback to science by providing sensors which can see further, magnify more, detect smaller and smaller energy fields, etc., and "effector" devices that produce higher speeds, higher pressures, higher energies, etc., which then allow the scientist to understand more and more of the physical (including the biological) universe. Some of that knowledge inevitably winds up suggesting more technological possibilities, so the "force multiplier" again feeds back to technology, which explains the current explosive growth in both science and technology.

Unfortunately, this rapid rate of technological progress is not necessarily permanent because it presupposes two conditions that currently exist but may not (and probably will not) exist indefinitely to the same extent. The first condition is that scientists must be aware that there is something they don't know but are potentially capable of finding out. The second condition is that the technology necessary for them to "try and find out" must be feasible. In the latter part of the nineteenth century, for instance, Newtonian physics reigned supreme, and it was quite a reasonable assumption that most further progress in physics would involve calculation of the same set of constants to more and more decimal places. Relativity and quantum mechanics changed all that, electronics arrived on the scene to provide

instrumentation, and the exciting state of "uncertainty" in science, with new knowledge arriving daily, was the result. This condition prevails now. By the year 2015 the same state should still prevail because the available technology (superconductive supercollider, for instance, plus many many other existing and potential tools) will not by any means have been exhausted for research. We cannot say with any degree of confidence, however, that progress will continue at the same rate in the year 2090.

It is critical to note here that progress does not proceed at the same rate for different technologies even in this time of unprecedented acceleration. There are mature technologies and rapidly changing technologies, and from the point of view of military procurement (mil. spec. doctrine, in particular) these require different approaches. In the civilian sector technological change has often been maintained (though not always accelerated) by means of "planned obsolescence" and gradual introduction of features into a series of product "generations." Annual changes in the automobile are an obvious example. Cars that would last a long time would delay introduction of new technology into the marketplace (although sometimes features are withheld intentionally so as to have something new for the next year's model). This practice, however, can become extremely wasteful in a mature technology. Razor blades, for instance, can be made to last much longer, but then there would be a much smaller market for razor blade manufacturers. The implications for military procurement are that in a mature technology the mil. spec. approach must stress durability to attain quality and savings over time, while in a rapidly changing technology one may be better off selecting low cost and flexibility/adaptability as more primary (given sufficient operational quality) so that one is not stuck with expensive obsolete items that never wear out. "Black box" replacement of technology components is a good approach here.

The third "force multiplier" for science and for technology (both separately and together - therefore with fourfold effect) has been and continues to be the increasing development and increasing general availability of more and more powerful computers.

In science computers play two separate functions. First, they allow more and more precise and rapid calculation of experimental results. Second, they are used to carry out "modeling" experiments, in which computations replace actual physical equipment. Both allow experiments to be carried out that would be otherwise impractical, or even impossible.

In technology, they enable tools and equipment (including scientific instruments - another "force multiplier") to be faster, more powerful, and, finally, more "intelligent" and enable production plants for the instruments and equipment to be themselves more efficient and more powerful, with robotic components. Product design is now routinely done with computer (CAD) tools, which are not only faster in calculations and routine tasks, but make it possible to design products (complex microchips, for instance) that it would be highly impractical to do without CAD tools. The development of computers is also currently in an explosive phase, likely to carry way beyond 2015.

Military technology has not only benefited greatly from this burgeoning explosion of science and technology but also has spearheaded the cutting edge of technology--supersonic flight, the atom bomb, space travel, computing at NSA, etc.--although it must be pointed out that the science was rarely INITIATED by the military. As Martin van Creveld points out:

None of the most important devices that have transformed war--from the airplane through the tank, the jet engine, radar, the helicopter, the atom bomb, and so on all the way to the electronic computer--owes its origins to a doctrinal requirement laid down by people in uniform. (Technology and War, 1989)

In the recent technological tour-de-force, Operation Desert Storm, in which a major war was fought with essentially zero casualties, except for the unfortunate impact of one scud missile (the effect of which can be reasonably labeled collateral damage) and effects of friendly fire (the latter having potential technological fixes for 2015), the casualties were of an order of magnitude that could reasonably be expected during a peacetime exercise (for the time and the number of men involved) because of intelligent application of superior technology and, one should admit, a little bit of luck. The United States population is very sensitive to casualties. The death of even one individual is considered tragic, and we have at times even sacrificed major foreign policy interests in the cause of recovering the remains of our kia's. Now that Desert Storm has shown that technology can provide a dramatic reduction in casualties (which was not at all as clear before Desert Storm), political support for casualty-reducing measures should not be hard to get and may even be mandated by the public. The argument that "we already have enough" can be countered by the fact that the next enemy will not be as vulnerable to surprise elimination of their air assets because of their very knowledge of our capabilities, and that we must forge ahead in electronic warfare to maintain the edge, as well as in electronic (IFF) measures to reduce friendly-fire casualties, which, of course are the most tragic.

## LIMITS TO TECHNOLOGICAL PROGRESS

Like everything else, technology has definite limits on its development, some of which are pretty formidable. It can be said with reasonable confidence that the efficiency of energy utilization, say, of gasoline in an internal combustion engine, can never exceed 100 percent (laws of physics say that it can never even attain 100%), so that the amount of improvement will likely reach a limit reasonably soon, beyond which it does not pay much to chisel away at that limit (nor can the weight of the car be reduced below "zero pounds" to compensate). This fact, of course, does not mean that more efficient engine designs are not a top priority, given the massive scale of their use, the pollution concomitant to inefficiency, and the exhaustion of non-renewable petroleum. In the area of funding, the resources allocated to science in the United States right after the first Soviet Earth satellite Sputnik I was launched grew for a while at an annual rate which would lead expenditures on science to exceed the gross national product in about 15 years - another unfortunate absurdity. Chemical processes such as those occurring in rocket fuels and explosives cannot yield much more energy than they do now. The speed of light is likewise a physical limit that now impacts a good number of technologies. Physics tells us that it cannot be exceeded.

One must be careful with theoretical limits, however. For instance, about three decades ago it

could easily be proven that the computer sitting on your desk right now (or on your lap, for that matter) is completely impossible. If vacuum tubes or even the newly invented transistors could be developed so that only one in a thousand would fail per year, a rate that seemed rather optimistic, a computer containing 365,000 tubes (or transistors) would be absolutely sure to fail and require repair every day (never mind the miniaturization that would be required to put such a beast on your desk). When we remember that now a single microchip frequently contains several million transistors, that chip alone should fail at least once an hour, and 60 of those chips should fail like clockwork once a minute. An impeccable argument in theory, but its consequences are fortunately averted by the absolutely incredible reliability of our microminiaturized devices. This is not to say that another limit of this kind cannot eventually bar further progress, but we are nowhere near it now in computer development.

A current example of a technology bumping up against the speed of light is the increase in computer processing (or "clock") speed. Every computer has a timing mechanism which ensures that things happen together in a certain order. Essentially, an electric pulse is sent to all the parts of the computer, ordering some to be turned on and some to be turned off at exactly the right time for the processing to continue. The early Apple computer was clocked at about one Megahertz, which means that a pulse was sent out once every millionth of second. At the speed of light this pulse travels about 300 meters before the next pulse is issued (actually, in a wire, electrical pulses travel a little slower), so that all the functional parts of the computer that need to be synchronized are "clocked" at about the same time, relatively speaking. The early IBM PC was clocked at 4.77 MHz, which is about five times faster, and the current PC's run at over 33 MHz, which is over thirty times faster. The rate of increase in this speed of the central processing unit was, therefore, about doubled every two years. If "progress" were to continue at the same rate, in 2015 each pulse would travel only about a centimeter during one cycle, and, therefore, to trigger all parts of a computer "simultaneously," the whole computer would have to be MUCH smaller than a centimeter. In 2030, the computer would have to be so small as to be invisible! Rather tough on keyboard design! This is not to say that other technologies (optical computers, for instance) and other computer architectures (for example, parallel processing), may not extend the effective processing rate to much higher limits. Parallel processing, which divides the computing task into subtasks handled simultaneously by semi-independent microchip computers connected together in arrays with successive array layers handling the results of the preceding array of component microcomputers, is clearly the wave of the future in overcoming the speed limitation of architectures based on a single central processing unit. Most major computer companies are, in fact, working on such designs, and some of them are already in use.

Other limits to technological development are the availability of trained personnel for all phases - scientists, engineers, and equipment operators/specialists, and, of course, funding, with competing priorities for painfully limited resources.

"The inventory that matters most walks home every day after work," says Paul Saffo, a research fellow of the Institute for the Future in Menlo Park, California. In his "Looking Ahead" column for the April 10, 1991 edition of The Los Angeles Times, Saffo raises the issue of the feared "professional gap"

in the United States: the declining number of Americans completing advanced degrees in technical areas that could cripple U.S. high-tech competitiveness. This "gap", he points out, failed to materialize in the 1980s, despite the fact that the proportion of foreigners earning graduate degrees in the United States (for example, in computer science) jumped from 32 to 45 percent in the 1977-87 period. No real shortage developed because many of these graduates elected to stay and work in the United States where they had better opportunities to work "on the cutting edge of their profession."

Nevertheless, the generation of scientists and engineers that entered the work force in the 1950s and 1960s will be retiring within the next decade, causing overall retirement rates to increase by 15 percent. This condition, combined with the declining graduate school enrollments in the sciences and engineering and increased demand for scientists and engineers could, in fact, result in a serious shortage of skilled professional personnel needed to maintain our high-tech edge. This situation could cause even our own companies to move abroad in order to remain competitive.

"Headhunters" from abroad (for example Japan and Taiwan) are already trying to lure technical personnel from the United States, particularly nationals of the country involved. Because the salaries they offer are quite competitive, the question why there is no greater exodus must be addressed.

One possible answer is that the research climate in the United States favors the creative individual rather than the docile team player (as in Japan), so that our best bet is to continue to foster a research environment in which the brilliant "mavericks" from all over the world will continue to settle in the United States regardless of salaries they could earn in their native countries. The salaries do matter, of course, particularly for retention of the more "routine" elements of the scientific work force. Mavericks alone cannot get the entire job done. They need support staff.

Despite what appeared to be great initial promise, educational technology has not really progressed as expected. Exceptions to this are military-sponsored efforts such as flight trainers, etc., but in the environment at large, educational technology is still largely limited to "computers imitating paper" and "talking-head" analog video presentations. One reason behind this is the cost of software development, which, unlike the case of personal-computer writing-tool and business software, has not been amortized by a mass market, and there is, in fact, no widespread realization that the resources required to develop educational software are as great as for any other software. Nevertheless, the potential remains. There is now equipment available for communication to a vast audience (personal computers, broadcast and cable channels, etc.), although the proper presentation methods for interactive training have not really progressed. The timetable for such progress is, unfortunately, impossible to estimate because no breakthroughs are visible in the near-term. Educators will continue to bemoan television while doing nothing to improve programming. It's not their fault, however, as they never really had access to resources even minimally adequate to the task (witness the millions of dollars it takes to develop a single commercial program for personal computers).

Education deficiencies place limits on technological progress by limiting the number of future scientists and engineers produced in this country (if the economic climate is favorable, we may still attract scientists from abroad), limiting the capabilities of the work force (already so limited), and limiting the

sophistication of the voting public in determining productive policies. Unfortunately, the voting public, unlike the scientific elite, cannot be improved by immigration except in the very long term. The military, with specific training requirements, may well be the ones to find the most efficient path to educational software and systems development. Among the obvious guidelines for progress is the use of communications media employing the strengths of that media, rather than imitation of former patterns (much as the early motion pictures imitated the stage). Unfortunately such progress cannot be forced, and we shall have to wait for ingenious educational use of our powerful new media.

With regard to resource limitations on the funding of science and technology, despite the somewhat faddish nature of favored support areas because of public hyper-enthusiasm when potential applications are announced and quick boredom if ultimate results are not instantly available, the "system" of government-industry-academic research and development has worked relatively well. This is why we are still ahead of the world in many of the basic scientific developments, particularly in areas where there is a national consensus on need and where established areas of research are accepted as essential. The downside, which is hard to avoid, is the necessity for basic-area researchers to devote a great deal of their time scrambling for annual funding. A research funding cycle of at least two years would be a great improvement.

The role of military sponsorship in basic research has been critical in many areas of science and technology, despite misperceptions on the part of a small proportion of the public that it's all going towards lethality (in fact most such research has been of general benefit and produced vast improvements in communications, space and environmental research). Some in the military may object in the other direction, that perhaps resources should be more focused on lethality issues. A rational middle position here should be a clear focus on the needs of the military as a system, with continual monitoring of which system components need improvement and/or can be improved through newly available technology. The use of components available in the general environment whenever possible, rather than mil. spec. everything to narrow and often limited or unrealistically high specifications could also cut costs if the planning is carefully done. The somewhat random and chaotic focus of the general research environment could be offset by the military focusing on "orphan technologies," areas of potential improvement that are not being pursued because of absence of public focus. Other areas that are identified as heavily researched by industry for its own needs could be de-emphasized by military research planners, even if there may be "glamor" in a particular research area.

The question of support of the industrial base by the military looms large, particularly in a period that begins with an apparently inevitable serious downsizing of the military establishment. Support for advanced research only, *per se*, is not necessarily sufficient. Someone actually has to manufacture the equipment in a timely fashion, particularly if the need arises for rapid mobilization. Experience has shown that in our system there really should be more than one source of procurement, otherwise there is no objective way to control either product cost or quality. If production lines are shut down and teams disbanded, we may face the same problems that emerged after the accident that destroyed the Challenger space shuttle. The absence of unmanned launch vehicles such as the Saturn to launch satellites critical

to national security became painfully obvious, and there was no way to revive Saturn--even its plans were apparently lost. On the other hand, we cannot afford to keep everyone funded. The delicate balance that seems to obtain between contract awards to Lockheed and Boeing surely represents one sensible approach.

What happens when an entire industry moves abroad, which happened to much of the U.S. steel industry, our consumer electronics industry, and tool-and-die making, and there is no one to support on the domestic scene without serious price inflation and counterproductive protectionism?

Because some industries are more efficient abroad it will be necessary to procure more of our military materiel abroad as well, making certain that several independent sources are cultivated, and that the major support goes to our political allies rather than our avowed enemies. This is not necessarily a bad thing because it is wasteful to duplicate production of items that can be made cheaper elsewhere. Such procurement frees up resources for other areas. As production facilities move abroad, however, some critical capacities are lost and difficult to regain. With the loss of heavy industry, for example, the production tool industry is moving abroad as well. If we do not support domestic capacity, perhaps supporting efforts to "leapfrog" plant automation practices that already have moved abroad by developing even more advanced systems, the tradition and art of large tool production, in which we formerly excelled, may be lost entirely. The future cost of this will be dear should the political conditions require the shift in emphasis to our own domestic heavy industry. There are no easy answers here, but selective support of high-tech industrial tool design and production by the military should help maintain some of this capability. The same applies to other areas of industry that we may be losing--"seed efforts" to maintain the skills are definitely in the long-term national interest.

The United States is currently in a strong position in areas such as chemistry, non-metallic materials, biotechnology (agricultural technology), computer hardware design, computer software, optoelectronics, telecommunications, energy source technology, and in the aircraft and defence industries producing military hardware, as well as in space technologies. These industries are likely to remain strong in the forecast period. Some effort to maintain our strength in these areas is logical for our military purchases.

One cannot overestimate the future importance of software. The software failure leading to the successful penetration by the Scud missile that caused the major losses in Desert Storm may well be a harbinger of things to come: as the military systems become more and more automated, the hardware becomes cheaper and more ubiquitous, the software will inevitably remain the weak link in the next 25 years. There is no avoiding it, because it is software that makes computers useful, and if any area is to be singled out in the need to maintain excellence, it is software. The present U.S. lead in software seems insurmountable because of the healthy domestic consumer industry as well as massive high-tech procurement by the federal government. We must be careful to support future developments in automated software design technology in order to maintain the lead. Automation of software production itself is inevitable in the long-term future, with significant developments possible during the forecast period.

With regard to our space program, history will, on the one hand, praise our landing on the Moon

in eggshell-thin spacecraft as a supreme triumph of human organization and teamwork as well as a miraculous technological feat, while condemning us for placing the effort in the context of a sporting contest with the Russians, with no future plan beyond the sporting event itself, rather than developing a serious continuing scientific effort. Would that we had worked truly for the future of mankind and established a working scientific and industrial colony on the Moon, with working settlements in space and perhaps even a Mars mission. None of this would have competed in any significant way with efforts to "improve things on Earth." Instead we have wasted precious lives and resources on politically naive no-win debacles of all sorts. The United States (or some other nation) will get back to serious exploration and development off-planet, but probably not within the time frame addressed by this report.

Not all research needs funding. Einstein's development of the theory of relativity could not really have been aided by any significant additional funding beyond, perhaps, some personal support. Theoretical mathematicians (especially before the "computer age") did much significant research using paper-and pencil alone. Some personal support grants in this kind of non-fund-intensive research may pay off handsomely, however, just because of the high cost/benefit ratio to the supporting organization, and because such support provides benefits to the general scientific infrastructure, which benefits all in the long run. On the other hand, some research is so costly that only combinations of governments can undertake it--the Mars manned mission comes to mind.

Foreign investment in U.S. research may be a mixed blessing, but in current economic circumstances, and with globalization of the utility of research results, it is unavoidable. If basic research that would otherwise have to be funded by the government is funded instead by the Japanese, other research money that our government (including the military) can put to good use is freed up. It is no longer feasible to keep basic research secret for any significant length of time, and denial of such knowledge to the enemy unfortunately denies it to our open-source research environment as well. This is not to say that specific military developments should not be kept to ourselves as long as possible (e.g. keeping the most advanced EW and ECM and C3 electronics out of the aircraft we sell to our allies until our own are upgraded to the next higher level) in order to maintain the edge.

Gross dollars devoted to technology as a whole are, of course, significant in maintaining progress, but they must be intelligently focused. The cost factor of technology generation upgrades to the military has been projected as a significant barrier. With present costs of sophisticated aircraft running well over a billion dollars, it has been said that in the future the armed services will be able to afford only a single super-high-tech aircraft! In addition, it takes about 15 years to bring a new generation of technology (in the sense of a generation of heavy equipment) to useful application. However, it must be remembered that it takes as much money to make a single memory chip of the kind described above (in terms of the cost of a plant to produce one, never mind R&D costs) as it does to make a B1 bomber, and yet a 256k DRAM chip can be bought retail for a buck and a half. Therefore, the military has a choice of either putting all its money into succeeding generations of increasingly expensive single-purpose platforms, or designing hardware in a modifiable modular fashion to incorporate future improved technology as such technology is developed, preferably in conjunction with developments in the open-market mass environ-

ments. The B-52 bomber has already been used in this fashion, which is why it still survives, while the B-1 could not yet even be used in Desert Storm. When costs of technology are cited as a barrier, the question must be asked what technology, when, and to what end. Replacement of black boxes with better black boxes in platforms designed for modular upgrade may well be the way to go.

The 2,000-lb GBU-24 laser-guided bombs used in Desert Storm are a case in point. They were conventional 2,000-lb "dumb bombs" fitted with TRW's Paveway kit at a total cost (bomb included) of \$20,000 each. This, according to the New York Times, is a dramatic reduction in price from 1988, when the Paveway kit alone cost \$40,000. Compare the \$20,000 figure with the \$1.3 million each cost of the equally successful Tomahawk missile used by the U.S. Navy in the same campaign. It's clear that unless the Tomahawk's extended range and unmanned delivery are critical to a mission, there is more "bang for the buck," literally speaking, in the Paveway conversion. Plans for a smarter reusable Tomahawk are, of course, under way.

In the future, this modification of conventional munitions to smart munitions is likely to continue and, possibly, to spread as well to "smart micromunitions," the rocket-propelled grenade being the first likely modification. Smart shotgun shells may well follow. Video cameras-on-a-chip, which already exist in the lab (cigarette-lighter-sized cameras delivering broadcast-quality video are being mounted on helmets of quarterbacks in the new WLAF World League American Football), may be followed by much smaller active devices that could allow the marine of the future to fire his weapon at 45 degrees elevation in the general direction of the enemy, and then select by video which ammo storage box, command-and-control node, gasoline tank, or, for that matter, which unfortunate enemy grunt he will hit. The obverse side of this picture is that the same weapons will become readily available to the enemy terrorist.

## TECHNOLOGICAL PROGRESS

A good example of a growing technology, exemplifying progress in the computer field, is the increase in the amount of random access memory (and consequent reduction in price per byte of memory) in personal computers, which is likely to continue through 2015, even if it does so at a slower rate than the present 400 percent increase every two years. When Apple first arrived on the scene, 16 kilobit (16,000 bit) DRAM chips were the vogue, and four years later when the IBM PC arrived, 64 kilobit chips were the rage. To make 8-bit "bytes," a "bank" of 9 chips is used (one chip for "parity checking" error diagnosis), so that with 4 banks of chips on the basic PC "motherboard," 16k chips yield a total storage of 64 kilobytes of memory, enough to store 32 pages of text (2,000 bytes per page). Now, twelve years later, the "state-of-art" installed chips have a capacity of 4 megabits each (4,000,000 bits), with a total 4-bank capacity of 16 megabytes of memory on the motherboard (enough to store 8,000 pages of text). More memory can, of course, be added by plugging in additional "memory boards." The next generation of chips (to be delivered in 1991 and user-marketed in 1992) contain 16 megabits each, with 64-megabit chips experimentally produced. The Japanese are already confident enough in the feasibility of 256-megabit chips to invest a significant amount of money in the planning of plants to produce them.

According to "Solid State Technology" (December 1990), Hitachi is constructing an R&D wafer processing facility in Ohme near Tokyo to be used for 256 Mb DRAMs.

The prediction of feasibility of chips with 1 Gigabit capacity (albeit somewhat physically larger in size than current chips) can be made with some reasonable confidence for the time frame considered by this report. A 4-bank motherboard memory with gigabit chips, by the way, would yield 4 gigabytes of memory, capable of storing 2 million pages of text. This is in the direct operational memory only! Such a computer will cost about the same as today (around \$2,000) or else the industry will not be able to sell millions of them and make a profit. Peripherals like laser disks can, at present, store about a gigabyte per disk (500 megabyte-disks being the most popular), which can store 500,000 pages of text. Disk media now under study (NTT's new optochemical hole-burning method, for instance) can potentially yield 1000 times that, about 500,000,000 pages of ASCII text per disk.

If this sounds like a large number, it is. The Library of Congress, in 1989, contained 19,000,000 books in its collection (plus over 70,000,000 other items) with an average of 385 pages each, so for books alone in ASCII text format, 14.63 trillion bytes of storage would be needed (according to Felix Krayeski of the Congressional Research Service of the Library of Congress), i.e., about 15,000 current-type laser disks or 15 of the possible future disks. A manageable number, but if you expect to have the Library of Congress in your collection in 2015, think again, because the problem of scanning even the current 20 million books page-by-page without damaging them (even by "intelligent robots" of the future) is a formidable task indeed. In graphic raster data (300 by 300 dots per inch) about 7,000 of the future disks would be needed, by the way. At any rate future (2015) published material (in principle) will become readily accessible to everyone with a telephone and a computer. This will include maps, art work, sound recordings, etc.

The brief consideration above of the issue of computer memory development is but a tiny sample of current progress in science and technology as a whole. A vast cornucopia inundating us with daily news of significant discoveries in physics, electronics, astrophysics (which is, strangely enough, critical to particle physics and the basic nature of matter), biology, biotechnology, cybernetics, medicine, etc., etc. (note the absence of social sciences), and new technological marvels are becoming everyday gadgets. Some of these are immediately useable by the military and incorporated in record time, such as the use of Japanese display panels in military aircraft, and the use of cheap geopositioning equipment, mass-produced for the boating public, by troops in Desert Storm.

A comprehensive view of the total picture of this progress in all areas is very necessary for military planners, but is unfortunately clearly beyond the scope of the present report.

## ASSESSMENT OF TECHNOLOGICAL PROGRESS

Precise assessment of the rate of technological change, especially if that rate is to be used as a gauge of current or future progress during a rapid development phase, is not as subject to simple mechanical calculation as it might first appear, even in the case of the memory chips above, where the

rate seems a straightforward affair. Microchip technology development depends, for instance, on development of the physics and chemistry of resists (photosensitive substances that allow patterns to be etched on the chips), imaging technologies in a multitude of bands from infrared through soft x-rays (each of these technologies is, in fact, a complex combination of many others), substrate development (encompassing a whole raft of materials technologies, including growth and processing of large crystals and their "doping" with exact amounts of impurities at precise microlocations), technologies for deposition of thin films of a variety of exotic substances, etc. When one begins to gauge the progress of devices in which the chips are only a small component, the problem looms even larger. The paradoxical result is that such assessments can be carried out, but the more precise they are, the more limited their usefulness for long-range prediction because change in any of the component technologies, either in a breakthrough or an unexpected bottleneck, can affect the whole process. For investment of near-term resources these assessments are, of course, invaluable.

On the other hand, one can get a useful "feel" of the current rate of change by considering the differences in parameters of devices in current use as compared to laboratory devices and rational projections of demonstrated capabilities of materials. Paul Zane Pilzer (Unlimited wealth, Crown Publishers, 1990) calls this the "technology gap." The thousand-fold increase in the memory storage capacity of compact disk material, mentioned above, being developed by NTT (Nippon Telephone and Telegraph, reported in "Solid State Technology," December 1990) is accompanied by a recording rate that is "...roughly 100 million times faster than existing storage materials. The contents of a full newspaper page can be stored with the material in 0.006 sec." Multiplying the capacity increase by the rate increase, we get a "technology gap" of one hundred billion. Even if the actual devices that may be developed from this technology (and, as pointed out earlier, there is no absolute guarantee of success in any particular enterprise) are "100 times worse," that still leaves a potential improvement factor of about a billion or so.

Taking another example from the February 1991 issue of "Lightwave," the fiber-optics industry news magazine:

Researchers at AT&T's Bell Laboratories said they have successfully boosted the speed and capacity of fiber-optic communications systems. The researchers reduced an intricate system of colliding-pulse mode-locked (CPM) lasers and fibers spread over a four-foot-by-six-foot laboratory table to an indium-phosphide chip measuring two square millimeters. The researchers then said they used the device to transmit 350 billion light pulses a second, each shorter than a trillionth of a second, through 24 kilometers of optical fiber. The fastest commercial fiber systems, by contrast, currently generate 2.5 billion light pulses.

Although AT&T said it doesn't expect to market a product containing the new device until the end of the decade, analysts said the Bell fiber system, together with advances in high-capacity fiber cable, could speed development of systems that can deliver studio-quality digital television signals to the home or office over telephone lines.

The area of the table is about 15,500 square millimeters, 350 divided by 2.5 is 140, and, neglecting the change in thickness of the equipment, we get an "improvement factor" of over 1,000,000.

Note that these two examples are even more impressive when one considers that they are single-stage improvements, not improvements over several iterations of developmental stages. Granted, these are extremes, but they were found at random over a very limited period of research time, and similar factors of over a thousand are quite routine in a wide variety of burgeoning technologies. Some emerging technologies, such as those involving recombinant DNA, or the development of artificial photosynthesis, are too new to have even such simple "improvement factors" assigned, yet their future impact may be gauged as highly significant, even revolutionary.

One important reality to note here is that the faster a technology progresses, the faster it will "bump up" against significant physical limits, to underline the realization that we are living in a period that can be called a tsunami of technological transformation.

#### **TRENDS IN TECHNOLOGY (METATREND--THE LARGE PICTURE)**

The development of technological applications has followed a repeated cycle, a metatrend, if you will, in which technology is first introduced, permitting a task to be accomplished in a better way, or in a way that could not have been done. This introduction, however, is often, if not always, accompanied by unavoidable loss of flexibility and convenience, frequently tying up personnel resources and presenting new difficulties. As the situation progresses, solutions to parts of the new problems in turn present problems of their own with regard to limitations in flexibility and convenience. Ultimately the technology settles down to a situation where maximum flexibility with maximum power prevails.

In military history (or prehistory, rather) the invention of the litter (the first vehicle, perhaps) permitted much more in the way of logistic supplies to be carried by a war party, but it tied up personnel, and much energy had to be spent to simply hold up the load, the supplies had to be guarded, and the direction of travel had to be determined by a "litter supervisor" (the first sergeant?). Addition of the wheel removed the need for human bearers to hold up the load, but limited travel to more unobstructed terrain. Addition of the ox (the first engine?) further removed the need for human motive power, making for a pretty nifty system, but too slow and vulnerable for a fighting vehicle. The horse-drawn chariot (the first military attack vehicle) was the next logical development, but it was still limited by terrain requirements and, more critically, subject to unwieldy "command and control," needing one man to drive and another to fight. The final development in the sequence miniaturized the vehicle and simplified the command-and-control to produce a truly efficient weapons system. The vehicle was shrunk to the dimensions of a saddle, and the cavalryman reigned supreme for centuries as the efficient standard military technology of an advanced society.

The power-to-weight ratio for the all-terrain vehicle was hard to beat, and the command-and-control was fully and flexibly integrated with the offensive and defensive weapons subsystems (sword and shield, etc.). The most sophisticated element was, of course, the computer and actuator subsystem of the weapons

platform (the cavalryman, of course), which still remains state-of-art, not likely to be replaced within the time scope of the present study.

In the history of computer development, a similar process has taken place, with the centralized-versus-distributed systems argument. The first trend was towards large expensive systems, because they were the only path to high computing power. Access to them was provided by operators servicing lines of users carrying packs of Hollerith "computer punch cards," only to see, all too often, a "system down" sign pasted on a closed upper door panel. After the packs were accepted, the users then lined up again to receive their packs back, plus a printout that all too often said "program failed" in embarrassingly large letters, visible to all the others in the line. Later the "system down" sign began to appear on what is now known as "dumb terminals," and the input of programs to the computer began to be limited as much by saturation of the telecommunications channels as by the mainframe computing power.

The next development might well have been the increasing power of the "dumb terminal," still basically attached to and inseparable from a mainframe, with the outcome being a highly centralized "smart system," epitomized by IBM's SNA (systems network architecture) with a rigid hierarchical arrangement of information processing. What happened instead was that some hobbyists, working in garages, developed a small all-purpose machine for other hobbyists, among which the Apple was the first large-scale commercial success, fueling a furious development of both system memory (chips), peripheral memory (disk drives, etc.), and other peripherals that, with volume sales, became cheap as well as powerful after the IBM PC anointed the personal computer as a full-fledged business system. Software costing millions of dollars to develop could then be sold in millions of copies rather than hundreds (or even dozens), with consequent impact on both price and quality.

The power of the PC now not only exceeds that of former mainframes, but includes sophisticated local storage that would have been impossible if the PC had not become a commercial commodity. Flexibility and power have been given to the user, finally, by the development of communications interface hardware and software, both among PC's and with mainframes (initially resisted by mainframe-types), so the user calls the shots, and, incidentally, creates a huge security headache. Information control of the type that could have been imposed by the authorities if the "smart terminal" rather than the PC path had been followed is now impossible. The user has the power of the mainframe at his fingertips and will have it even more so in 2015, the time frame projected by the Japanese (NTT) for a complete user-to-user fiber-optic communications network, also likely to be attained by that time in the United States. The process of going over completely to fiber in the telecommunications system has to take about that much time, of course, because of the enormity and cost of the physical task, but the course of it is one of the most predictable aspects of technology at the present time. Parallel-architecture computers should also come into their own in this time frame, the greatest difficulty in their implementation being software development (else they could flourish even sooner).

The most significant element here, however, remains the fact that computer/communications technology has basically passed over the hump of inflexibility, unwieldiness and inconvenience, by way of empowering that same "cavalryman" above to call the shots flexibly within a comprehensive integrated

command-and-control network.

The functionality of the integrated ALB battlefield was held in some doubt until Desert Storm even by a brilliant analyst like Martin Van Creveld, who speculated that with current-level battlefield integration, the low-tech side may at times have the advantage because the battlefield can become "frozen" for the high-tech side, with no force component able to move unless another moves first. In fact, as Desert Storm has shown, if sufficient tactical flexibility devolved to the individual platform (tank, aircraft), the individual platforms in the integrated battlefield could function brilliantly, selecting alternate targets and targets of opportunity, using the central command network for coordination purposes, while being guided by it for the larger tactical objective, and being provided by it with information needed for survival as well as for effective delivery of munitions to target.

## TRENDS AND COMBINATIONS

Some of the principal trends in technology are cited below. Many of them act as change drivers on each other. Thus electronic miniaturization goes hand in hand with increase in processing speed, and the requirement for processing speed mandates miniaturization, because of the basic limits of the rate at which a signal can travel in a wire, as explained earlier. This "bumping up" against the speed of light itself as a barrier in turn mandates development of parallel processing architecture, where one gains total speed by having several microprocessors handle different parts of the task at the same time, which again requires changes in the way software is written so that separable parts of a task can be segregated and sent to different microprocessors. In the quest for better, faster, more reliable, more secure, etc. ANYTHING, new materials and processes come under examination, with the result that there exists a potential for radical change in materials science. The development of thin film technology permits new developments, such as diamond film coatings of tools, and it is not unlikely that growth of larger crystal structures will become possible in the future, given the current rate of progress. These same diamond films are an excellent substrate for computer microchips, allowing faster and more radiation-resistant components to be fabricated. Other materials of potential significance abound, such as the recently reported silicon insulator materials for CMOS technology developed by IBM ("Byte," February 1991). The number of such technological areas of potential significant progress is so large and changing so constantly that it defies enumeration, and the only rational way to keep up with it is through adoption of large-scale continuous monitoring projects conducted by knowledgeable science generalists in consultation with specialists in the many industries involved.

In addition to the physical sciences, which we have emphasized, the recent development of genetic engineering holds such radical change potential for biology that reliable prediction for the 2015 time frame is quite impossible, except to note that the Human Genome project, mapping the total of significant genetic information comprising the human being, is slated to be completed well before then, and current biotechnology has already proven that it can perform as expected, in a safe way (not according to Jeremy Rifkin), with dramatic results. Organisms have already been patented as products, including ones as

complex as a mouse. And "killer genes" within some cells that lead to their shortened life span, in conjunction with many many other ongoing and future relevant studies, may well provide a clue to the puzzle of human aging. This breakthrough could be followed by the discovery of powerful agents for the prevention or even reversal of aging, a contingency that could turn out to be the greatest disaster of all time, or the greatest change agent for humanity.

Suggestive lists of some issues and developments follow, which are, of necessity, far too short for comprehensive guidance.

## GENERAL TRENDS

### INCREASES IN:

- speed
- power
- efficiency
- durability
- planned obsolescence
- miniaturization
- complexity
- automation
- modularity

### INCREASED REQUIREMENTS FOR:

systems organization

- systems centralization

- distributed systems

management of finite resources

- conservation

- recycling

extension of knowledge of natural processes

- physical sciences

- biological sciences

extension of knowledge of humanity

- psychology

- sociology/anthropology

- history/archaeology

extension of knowledge of the environment

- Earth - surface, subsurface, sea, undersea, atmosphere

- near-Earth

Moon-Mars-Venus

Solar system

Universe

## **PROBLEMS CAUSED BY ACCELERATING PROGRESS**

adaptation to accelerating rates of change

rapid obsolescence of older systems

long lead times for development/deployment of large new systems

mix of generations of weapons systems

increased cost of new weapons platforms/systems

upgrading of older technology with new electronics & weapons

globalization of science, technology, industry, communications

short-range focus in development

changes in industry research funding patterns

"shooting star" fads in science

## **TECHNOLOGY ISSUES FOR THE MILITARY**

### **1. Smart weapons/munitions**

#### **A. power availability/delivery**

active payload

efficiency

#### **B. control processes**

fuzing

guidance

collateral damage control

damage assessment feedback

#### **C. platforms**

delivery

guidance

coordination

### **2. Military vehicles - manned and unmanned, mission-related**

#### **A. land**

#### **B. sea**

#### **C. undersea**

#### **D. amphibious**

#### **E. aircraft**

- F. spacecraft
- 3. Intelligence-related technology
  - A. surveillance - local, midrange, remote
  - B. target pool identification
  - C. damage verification
  - D. HUMINT
  - E. countermeasures
- 4. C3
  - A. centralized vs distributed command
  - B. secure and robust communications
    - encryption/decryption
    - signal hiding
    - IFF
- 5. Logistics
  - A. potential for hardware and software in
    - planning
    - procurement
    - distribution
    - repair and replacement control
- 6. The individual as "superwarrior"
  - A. "amplification" of the individual
    - the individual as command/control center
    - the individual as a plug-compatible module
- 7. Potential from biotechnology and medical technology
  - A. possible developments in genetic control
    - as weapons - designer gases, designer pests
    - as protection
    - as soldier selection/design means
  - B. public health issues
- 8. Environmental controls (weather prediction/control)
- 9. "Wild Cards"

## **TECHNOLOGICAL DEVELOPMENTS RESULTING FROM ADVANCES IN THE PHYSICAL SCIENCES**

### General considerations:

useful to start with a large list

useful to mix development levels (a particular chip and a potential product using that chip should both be regarded as separate developments)

A. Energy use and development

- photoelectric cell
- energy co-generation
- artificial photosynthesis
- food production
- fuels - hydrogen, methane
- MHD
- fuel cells
- high-energy-density batteries
- liquid hydrogen
- synfuels
- windmills
- tidal power
- bioelectric power
- bioluminescence
- extraterrestrial
  - orbital microwave station
  - wide-spectrum conversion of solar energy
- nuclear
  - fission
  - direct conversion (beta emission)
  - fusion
  - space-based nuclear plants

B. Transportation

- superefficient internal combustion
- petroleum fuels
  - liquid
  - gaseous
- hydrogen
- methane
- maglev trains
- superconducting-drive vehicles
- superconductive intelligent highways
- cellular-radio-control traffic routing
- automated intracity traffic flow

- supersonic/hypersonic transport
- aircraft/vehicle intelligent diagnostics
  - on-board real-time
- aircraft intelligent traffic control
  - automated routing
- moon mission vehicles
- Mars mission vehicles
- advanced space propulsion systems
  - photon sails
  - proton rockets
  - nuclear
- advanced hybrid vehicles
  - land/air
  - ground effect (air cushion)

#### C. Communications

- rational allocation and utilization of the electromagnetic spectrum - spread spectrum, satellite-routed, laser
- digitalization of all transmissions
- fiber-optic communications
  - fiber subscriber loop
  - integrated service
  - interactive systems
  - information service access
  - ultrahigh-definition video/multimedia
- passive transponder tracking
  - military IFF
  - personnel tracking
  - vehicle tracking
- universal portable cellular two-way communication
- computer card money - no paper
- decentralized education services
- computer display art forms

#### D. Materials

- new lightweight strong materials for
  - aircraft/spacecraft/vehicles
- new construction materials
  - laminates, etc
  - carbon fiber

- new plastics
- new glass materials
  - controlled opacity
  - controlled color
- crystalline coatings
  - diamond
- new materials for computer technology
  - thin films
  - new crystals
  - organics
- new organic materials
  - food
  - medicine
  - structures

#### E. Other

- novel weapons concepts
- weather control via space-based energy plants
- pinpoint all-planet surveillance and targeting with intelligent systems controlling the process
- other...

### **TECHNOLOGICAL DEVELOPMENTS RESULTING FROM ADVANCES IN INFORMATION PROCESSING**

#### A. Computers

- hand-held supercomputers (3000 times more powerful)
- extra-large superchips
- REAL automated software engineering
- REAL artificial intelligence
- parallel architecture hardware
- parallel architecture software
- superhigh-density displays
- projection displays
  - heads-up displays
  - large wall-projections
- instant access to all written literature
- automated studies

The "Son of Army 21" study --

--ARMY 45 (2015-2045) may be done by an intelligent computer program  
voice recognition interfaces  
standardized plug-compatible heads-up display systems  
three-dimensional displays  
at last a really decent universal computer language  
at last a true universal Application Program Interface

B. Automation

automation of production  
superflexible factories manufacturing to individual order  
automation of all  
    vehicles  
    instruments  
    appliances  
    weapons  
automated recycling utilities  
    based on current sewer systems  
    other  
service robots  
    special purpose  
        household chore machines  
        guard robots  
        roving military mission robots/weapons  
    general purpose robots (read Isaac Asimov)  
    micromachines  
    microsurgical robots in arteries  
    microspy mobile intelligence gathering devices  
    microweapons - miniature killing machines  
    fabrication "teams" of micromachines  
space-based production facilities  
planned development of the Moon for research, industry and habitat

C. Data collection, transmission, analysis

integrated heads-up displays for  
    remote vehicle control  
    integrated military mission modules built around the operator and plug-compatible in a  
variety of platforms and configurations  
fractal image compression for  
    video  
    terrain-following systems

target recognition

D. Artificial intelligence

functional neural networks

multi-field "expert knowledge" systems

Very Massively Parallel architectures with

self-learning software

machines designing intelligent machines

machines designing the human physical environment

machines designing a rational social environment (according to whom? or is it "according to what")

medical diagnosis system accessible through the universal communication system (outgrowth of the present phone system)

job-location and need-resource matching systems

E. Research and automation interaction

## TECHNOLOGICAL DEVELOPMENTS RESULTING FROM ADVANCES IN LIFE SCIENCES

A. Public health issues

AIDS, famines and other health disasters vs overpopulation due to truly effective medicine and abundant food supplies

ethics of biotechnological manipulation of human genetics

B. Biotechnology

completion of the Human Genome project with resulting

life extension

temporary

indefinite

organ regeneration

designer drugs for physical ailments

"friendly" chemical warfare agents

"designer gases" to make the subject happy, placid and essentially immobile for a day or two without ill effects

countermeasure drugs for same

much more efficient food production

design of superintelligent, supercapable humans (maybe supersensible too...NAAH)

breeding of "designer servants," "designer soldiers," "designer generals"

design of brand new currently unimaginable species

design of truly intelligent species based on the total planet "supergenome" rather than

simply the limited human genome

## SOME POSSIBLE PROJECTIONS FOR 2015-2020 FOR SAMPLE TECHNOLOGIES

### Incremental change projected:

- Electrochemical storage batteries
- Tires
- Road construction materials and methods
- Building construction methods and materials
- Railroad equipment and trackage
- Airport design/construction
- Internal combustion engines
- Home appliance basic processes
- Electrical power networks
- Chemical explosives, propellants

### Generational Change projected:

- Electromagnetic spectrum allocation for communications
- Radio broadcasting - all-digital format
- TV broadcasting - all-digital very-high-definition format
- Civilian aircraft and air traffic control systems
- Telephone communications networks - all wideband fiber-optic
- Mainframe computers
- Automobiles - computerized control/diagnostics, safety
- Industrial plant automation
- Space travel
- Information access (to existing published info)

### Radical change projected:

- Personal computers
- Data storage/access media
- Personal communications equipment, including video
- Information access (to newly published info)
- Home appliance control - intelligent controls built-in
- Automobile accessories - extensive automation, nav aids
- Surveillance/reconnaissance technology
- Precision-delivered munitions, including smart micromunitions
- Visualization/display technologies

Unknown change projected (incremental to radical):

Medicine  
Human performance enhancement - physical, mental  
Agriculture  
Animal husbandry  
New organism design/production  
Nuclear fusion  
Room-temperature superconductivity  
Optical computers  
Holographic storage/retrieval  
Micromachine technology  
Social sciences

With regard to the need for planning, according to Martin van Creveld:

The long lead times of up to 15 years that often characterize the most modern technologies in particular means that most wars have to be fought with the hardware at hand. However, those very same lead times also signify that planning has to commence years in advance and involve educated guesses concerning the nature and effect of devices which, as yet, exist only on the drawing boards, or simply as semi-articulated ideas in the minds of inventors. The conflicting demands of readiness and of preparation, of present and the future, make this task extremely difficult. No wonder it has spawned an entire new industry, commonly known as **technological forecasting**, that has much in common with the ancient hocus-pocus. (emphasis added)

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(A note on sources. News of technological developments are so ubiquitous as to appear in literally thousands of sources. Indeed, the news distribution process has itself become a part of the "technology environment." Suggested readings to remain informed depend on individual interest, but in addition to major daily newspapers (for example, New York Times, Washington Post) and periodicals like Aviation Week, one excellent source is the weekly publication Science News. Industry magazines and newspapers such as Infoworld, Lightwave, and Solid State Technology should be considered information standards.)

## KEY JUDGMENTS

### UNITED STATES MILITARY SCIENCE

- By the year 2015 the United States will still play a large role in ensuring the stability of the international balance. The United States will have key strategic interests in the Persian Gulf, Europe, the Pacific, and Latin America.
- The Soviet Union will occupy a position of prime importance in U.S. strategic planning even if that country is weakened by internal political problems and economic crises.
- The arms race will have been scaled down and the development of weapons necessary for maintaining deterrence against the Soviet Union will probably take place at a slower pace. The United States will continue to rely on a modernized mix of nuclear systems that hold critical Soviet assets at risk.
- The threat of nuclear weapons proliferation to smaller, developing countries will be a greater problem than the Soviet threat. Space-based surveillance will be used to monitor arms control and anti-proliferation agreements with increased effectiveness.
- By the year 2015 the number of nations possessing nuclear weapons will have more than doubled. Nuclear war will increasingly be viewed as an unacceptable alternative for achieving military and political aims. The primary focus of nuclear weapons will be on the proliferation problem rather than superpower confrontation.
- In the event of high-intensity conflict, large quantities of weapons systems, with unprecedented range and lethality, specifically, non-nuclear strategic capability (NNSC) would be fielded by combatants. Projection of air power would be especially vital since the United States will have a much smaller military force designed to respond to medium- and low-intensity conflicts. The closing of overseas bases and demobilization of U.S.-based forces will have affected force structure, making it more difficult to project power on a global scale.
- Conventional battle will most likely be obsolete, replaced by low-intensity conflict (LIC). This type of third-world conflict will require the understanding of cultural, historical, economic, and social roots of turmoil as well as the political/military. The Army would be well served by an enhanced Foreign Area Officer Program, wherein the warrior-scholar would be of great value to the nation.
- By the year 2015 the advanced technology of the U.S. military will provide the maximum warfighting potential from less manpower. A smaller, home-based, highly professional army will be the order of the day.

## **UNITED STATES MILITARY SCIENCE TO 2015**

### **STATE OF THE ART TODAY**

#### **The Strategic Environment**

As a global power, the United States has global interests. Defining those interests in a highly uncertain, constantly changing strategic environment is both a political and a military task. Most military thinkers agree that the changes in Eastern Europe and the Soviet Union do not mean that the threat to American interests around the world is any less. Although the Soviets are clearly looking inward and focusing their attention more on longstanding internal problems than on military competition with the West, the ultimate direction of Soviet change is not yet clear. Furthermore, as the war with Iraq serves to remind the U.S. military, new security challenges are arising in other areas of the world. Since World War II, the developing world has experienced on average at least 25 internal and international conflicts each year. [1] Many developing nations are gaining increasingly formidable and sophisticated weapons, including nuclear and chemical weapons. And terrorism and insurgency are on the rise everywhere.

The goal of U.S. national security policy today is to preserve the United States as a free and independent nation, a goal that is furthered by interrelated political, economic, and defense strategies. The foundation of U.S. defense strategy is deterrence, based on nuclear and conventional forces, as well as on international alliances and power projection capabilities. Although the first priority of U.S. defense strategy continues to be that of deterring nuclear attack, the U.S. has commitments and interests around the globe that require U.S. military forces. Conventional capabilities are seen as essential to deter and contain local conflicts that might threaten the interests of the U.S. and its allies.

#### **The Operational Continuum**

At present the Joint Chiefs of Staff takes a view of military science that extends beyond straightforward battle doctrine and encompasses broader strategic concepts. One of these concepts is the so-called "operational continuum," which basically describes the various levels of interaction between nation-states. The first level of interaction is peacetime competition between nations. This includes trade, technological and military competition, and efforts to extend military influence beyond borders. These activities have been termed "operations short of conflict."

The next level of the continuum is conflict that falls short of war. This could arise out of insurrection or instability within one country that creates broader instabilities in the region. Conflict might mean that the military makes a show of force in another country and even carries out raids or surgical strikes, such as the United States did against Libya, Grenada or Panama. The third level of the continuum is all-out war, either limited and regional or global.

### Joint and Combined Operations

Joint operations is a fundamental tenet of current U.S. military doctrine. It refers to the basic chain of command, which begins with the President of the United States, goes through the Secretary of Defense to the Chairman of the Joint Chiefs of Staff and then to the Theater Commander-in-Chief (CINC). The CINC is responsible to the Secretary of Defense for accomplishing his designated mission and operates under the strategic direction of the JCS. This is a so-called unified command. The individual services are responsible for providing their contingents to the CINC. In addition to joint operations, the U.S. military also prepares for combined operations with land, air, and naval forces of allied governments. Doctrines, procedures, and principles have been developed to enhance inter-allied coordination. The recent war with Iraq exemplifies the concept of combined operations.

### AirLand Battle and AirLand Battle-Future

The AirLand Battle Doctrine describes the Army's approach to generating and applying combat power at the operational and tactical levels. [9] The concept of AirLand Battle is based on the three-dimensional nature of modern warfare and the view that all ground actions above the level of minor engagements are greatly affected by the supporting air operations of one or both combatants. AirLand Battle Doctrine recognizes that modern warfare is likely to be fluid and nonlinear, so it takes an enlarged view of the battlefield and emphasizes unified air, ground, and sea operations throughout the theater.

AirLand Battle-Future (ALB-F) or AirLand Operations, which will become doctrine within two years, is a refined version of the AirLand Battle concept. Basically, it assumes a smaller army with improved technology that will enable the U.S. military to find the enemy at greater depth than ever before. Such precise location of enemy formations will allow the U.S. military to accept gaps between its units and to maneuver a reduced number of forces. Technology also will facilitate precision deep strikes against the enemy such as those achieved by the laser-guided bombs of Operation Desert Storm. ALB-F/ALO places more focus on enemy forces as the objective than airland battle doctrine. ALB-F/ALO is likely to remain army doctrine into the early years of the 21st century, but numerous outside factors could change this doctrine before the year 2015.

### Nuclear War Doctrine

United States strategy towards nuclear war has evolved around several key concepts during the past 25 years. Because the devastating effects of nuclear war have been generally acknowledged, these concepts are based on deterrence and escalation control, while scenarios for nuclear war that have been posited have tended to focus on Soviet objectives and intentions. NATO allies, for example, have long

debated the question of what form of "flexible response" would be most effective in meeting a Soviet conventional threat. And increasing efforts were begun in the 1980s to develop nuclear weapons that would permit a limited response to Soviet aggression rather than an all-out nuclear attack.

Recognizing that nuclear weapons are too terrible to be used, U.S. military thinkers have discussed nuclear warfighting strategy largely in terms of how the United States and NATO would respond to Soviet aggression. At the same time, however, because maintaining a nuclear balance has long been seen as the key to deterrence, the United States and its allies have devoted tremendous expenditures to building up a nuclear arsenal. They have shared a belief that a modernized mix of nuclear systems is essential to holding critical Soviet assets at risk. Recent developments have caused U.S. military scientists to reassess this strategy. The dismantling of the Soviet empire in Eastern Europe, the moves within the Soviet Union to introduce democratic reform, and the willingness of Soviet officials to engage in concrete arms control agreements have given rise to an increased emphasis on arms control and a general recognition that the nuclear debate is becoming increasingly irrelevant to global realities. Discussions about the nuclear threat now center just as much on nuclear proliferation as they do on the Soviet nuclear arsenal, making nuclear arms control an even more important U.S. strategic aim.

## **NATIONAL SECURITY INTERESTS AND OBJECTIVES – 2015**

As a superpower, the United States will continue to have strong global interests in the year 2015. Communications and transportation technologies will shrink the world at a rapid pace, a process that could transform the world into a global community. Collective security arrangements and politico-economic alliances will unite individual states into larger bodies. Strategic decision-making will take place in the context of multinational bodies like the United Nations. Greater security cooperation among states will be furthered by environmental and economic concerns, which extend well beyond national borders. Issues such as global warming, overpopulation, and the depletion of the ozone layer will create a basis for new global agreements that will set a pattern of increasing inter-dependence and mutual cooperation among nation states. Such interaction will have a direct impact on security matters.

The United States will continue to play a large role in ensuring the stability of the international balance. The United States will have important strategic interests around the world, especially in the following areas:

1) Persian Gulf - By 2015 the United States could be more self-sufficient in terms of energy requirements, but this is doubtful. It is more likely that the nation will still depend heavily on the Middle East for oil and will continue to deem this an area of key strategic interest. The political complexion of the Middle East will have changed considerably from what it is now. Islamic fundamentalism will be the driving force in the region, replacing traditional forms of rule by oil sheiks. This fact will create widespread instability and pose new challenges for the United States in protecting its interests in the area. In general, we will support friendly states and act to prevent hostile powers from acts of aggression in the region and from gaining control of oil supplies and communications.

- 2) Europe - The United States will continue to have a close security and economic relationship with the countries of Europe, although it is likely that NATO will be more a political than a military alliance by 2015. As in the past, the United States will consider part of its national security concerns to preserve a peaceful and economically stable European community. Though our forces will be reduced, we will maintain our commitment to European security. This will be seen as necessary despite the Soviet withdrawal from Eastern Europe and the other indications that it is modifying its traditional security priorities. According to one source: "Although internal weakness and political disarray contributed to the need to retreat from cold war confrontation with the West they [the Soviets] also may serve to paralyze security reform." [4] In other words, it cannot be assumed that by 2015 the Soviet Union will no longer pose a threat to Europe.
- 3) The Pacific area will grow in importance for United States security interests, although our interests will be less focused on the traditional threat. Worries about Communist insurgency will recede in the face of new challenges. Japan will remain the dominant economic power, although it is unlikely to change its security policy, which is non-interventionist and pacifistic. China, on the other hand, will be a nuclear power to reckon with. Many experts expect China to exercise far more power and influence in the early 21st century than it has in the past. Despite China's growing importance, Marxism-Leninism will probably have little appeal for third-world states of the Pacific area, such as the Philippines. And the Soviet Union may be so involved with its own internal problems that it will not be making substantial attempts to influence political events there. Nonetheless, violence and armed conflict will become increasingly prevalent as population and poverty swell, thus creating a security concern for the United States.
- 4) Latin America - The American hemisphere will take on new strategic importance for the United States towards 2015. Overpopulation, environmental, and economic problems will cause increasing societal disruption in Latin America. Therefore we can expect greater political instability and violence. The U.S. military will view such instability as a threat to its own strategic security and will therefore maintain a readiness to intervene militarily when such a threat warrants intervention.
- 5) As in the past the Soviet Union will continue to occupy a place of prime importance in U.S. strategic planning, even if the Soviet Union is considerably weakened by the dissolution of its unified state or burdened with economic and ethnic problems. Maintaining stable nuclear deterrence in relation to the Soviet Union will still be an aim of U.S. policy, although it will not be in the forefront of U.S. strategic concerns. Given the state of the Soviet economy in 1991 and the extent of its internal political problems, it is unlikely that the USSR will be able to maintain the pace of technological advancement in either nuclear or conventional weapons that it has maintained in the past. Therefore the arms race will likely be scaled down and the development of weapons necessary for maintaining deterrence against the Soviet Union will probably take place at a slower pace.

Although the United States will continue to rely on a modernized mix of nuclear systems that hold critical Soviet assets at risk, the threat posed by the proliferation of nuclear weapons in other, smaller nations will be perceived as just as great a problem as the Soviet threat. Indeed, according to most

scenarios, proliferation of nuclear and conventional weapons throughout the world will continue well into the 21st century. [27] Tensions, therefore, will be high, and armed conflict, as a means for nations to protect their economic infrastructures, will be an ever-present threat.

It is, of course, impossible to predict where and against whom the United States will have to focus its military strength in 2015. Colin Gray says that the future of international security politics is likely to be very much like its past. Alliance ties may alter and technology will shift, but strategic geography will remain a critical subject with persistent implications for U.S. defense planning. [11] An important principle that Gray postulates for this period is to "retain the flexibility to adjust to change."

Another probable security concern for the United States will be the growing incidence of low-intensity conflict in all areas of the world. (See discussion below.)

As Gray points out, the classic threats to the United States are receding, but this does not mean a more secure world for the future. More than likely what the United States will face as a security concern in 2015 are serious political upheavals in East-Central Europe, including the Soviet Union. For this reason it will be in the interests of the United States to maintain some sort of military presence in Europe, perhaps as a counterweight to a united and economically strong Germany. It is quite possible that the United States will continue to lose economic influence in Europe, particularly with the expanding role of the European Economic Community (EEC). Nonetheless the United States will still be a superpower and, as such, will be called upon to confront any threats to the balance of power in Eurasia. As Gray notes: "By virtue of its economic size, the scale of its military forces, its global mobility and the cover of its nuclear deterrent, the United States will remain in a class by itself as a power for order and stability." [11]

One alternative scenario to the one which postulates that the United States will be a superpower with global interests in 2015 is one which places the United States in an isolationist stance. [27] According to this scenario the United States remains a prosperous postindustrial state, but other nations have achieved new international economic status and increased power and prestige in their regions. This changed status has had an adverse affect on U.S. international political influence and caused U.S. forces to be dispelled from all overseas bases. The United States has, as a result, turned inward and become more isolationist, concerned with social welfare, environmental and other internal issues. In this scenario, U.S. reliance on nuclear deterrence is much greater than it was at the turn of the century.

### **Potential Impact of Arms Control**

The arms control process will continue to be centered on the Soviet Union. Although events of the past few years have given the United States some cause for optimism about bi-lateral agreements with the Soviet Union, the arms control process will be lengthy. Given the extent of its economic problems, the Soviet Union has a high incentive to further the arms control process, and to work for cuts in both nuclear and conventional forces. Yet the highly turbulent political environment in the Soviet Union might in the long run work against arms control. Arms control efforts will also be directed at the problem of

nuclear proliferation. Negotiations will be a highly political process, most likely linked to forms of economic aid as a means of leverage.

## NUCLEAR WAR IN 2015

Most experts agree that the trend toward less emphasis on nuclear weapons in strategic planning for possible wars between the global superpowers will continue. Nuclear war will increasingly be viewed as an unacceptable alternative for achieving military and political aims. The risk of arousing politically damaging opposition at home, together with the problem of limited economic resources, will put more and more restraints on nuclear force planning. Although the United States will continue to build nuclear weapons, nuclear weapons could become so discredited domestically that the United States will have great difficulties persuading its adversaries that it will employ these weapons. However, the American public would likely demand retaliatory use of nuclear weapons if U.S. forces were subjected to nuclear or chemical/biological attack.

One analyst has observed that "with respect to nuclear weapons, United States thinking since World War II has gone from fascination with things nuclear to appreciation of the limitations of such weapons." [25] Smith and others argue that there will continue to be a general desire among the nuclear powers to avoid destroying the world. Nonetheless, nuclear weapons will be still be very much around in 2015, and any war fought between the superpowers will be fought in the nuclear environment. As a result, if one side is on the verge of military collapse in a conventional war, the nuclear reality will be at the very least reckoned with. Smith asks: "Would the Soviets choose to lose a war of conventional forces rather than initiate the use of nuclear weapons themselves?" and goes on to observe: "Few would argue that the Soviets would never think such thoughts; clearly nuclear weapons will continue to be a factor in any war between major powers."

Ironically, this future scenario that advances with the possibility of the use of nuclear weapons might be made more likely as a result of technological advances in conventional warfare. One source suggests that a future form of high-technology, fourth generation warfare might carry in its seeds of nuclear destruction. Its effectiveness could rapidly eliminate the ability of a nuclear-armed opponent to wage war conventionally: "Destruction or disruption of vital industrial capacities, political infrastructure and social fabric, coupled with sudden shifts in balance of power and concomitant emotions, could easily lead to escalation to nuclear weapons." [14]

In general, experts foresee a continued reliance on deterrence as the basis for U.S. nuclear policy. Arms reduction agreements such as START will result in balanced and reduced offensive forces, but the mission of deterrence will endure and the triad concept will remain fundamental to this strategy. Some insist that the United States will also continue to need modern theater nuclear weapons as a deterrent aspect of the NATO strategy of flexible response. On the other hand, one study concludes that "flexible response will be a mere anachronism if Europeans prohibit the modernization of theater nuclear forces or if such forces are reduced to zero through negotiations -- or if we find that our theater nuclear

weapons are targeted at a democratic Eastern Europe." [8]

Technology of course will also shift the course of nuclear planning by the year 2015. Indeed, some argue that the continued development of the Strategic Defense Initiative (SDI) takes the defense against nuclear weapons from the U.S. military and places it in the hands of technology. One analyst observes that by 2015 nuclear warfare will already be totally in the realm of space: "If nuclear weapons continue to exist it seems appropriate that their venue be deep space rather than our small, blue planet." [19] Whether or not this scenario is realistic, one thing seems clear. Space-based surveillance systems will be so advanced technologically by 2015 that arms control agreements with other major powers will be monitored with 100 per cent effectiveness. Therefore arms control will continue to be a key element of U.S. strategic policy in the nuclear realm.

The main focus of nuclear weapons in the future will be centered on the problem of nuclear proliferation rather than on super-power confrontation. By 2015 the number of nations possessing nuclear weapons will have more than doubled. As Defense Secretary Cheney has observed: "Advanced technology can make third-class powers into first-class threats." [3] The possibility that regional conflicts will become nuclear ones will be one of the greatest threats facing U.S. security planners in 2015. This situation will not only keep the nuclear question very much alive; it also could reduce United States willingness to deploy forces around the globe because of the danger that these forces would be attacked by a hostile regional power. Here too, however, U.S. space surveillance capabilities will at the very least enable military planners to pinpoint the danger spots with total accuracy and eliminate all elements of surprise.

## CONVENTIONAL WAR IN 2015

### High Intensity Conflict

This type of conventional warfare is global in scope and objective, entailing the use of all domestic resources over a long period of time and most likely being a major world war with all the superpowers involved. This is the level of conflict that is directly below nuclear war on the scale of intensity and could escalate into nuclear war. High intensity conflict is likely to be highly destructive and extend across a wide space of air, land, and sea. Combatants in this type of war would field large quantities of high quality weapons systems, with unprecedented range and lethality. Power projection capabilities of the air force would be especially vital in such a war, since the ability to reach all over the globe from just a few bases would likely be achieved by 2015. Complementary Air Force and naval operations would play a prominent role. Wide-ranging surveillance and communications technology would increase the range and scope of the battle. Chemical and biological weapons are likely to be encountered.

High intensity conflict requires the projection of conventional forces to parts of the globe where there are no pre-positioned forces or supplies. The power projection capability will be especially

important in 2015 because the United States will have a much smaller military, designed to respond to medium- and low-intensity conflicts. The loss of overseas bases and the demobilization of U.S.-based forces will have affected the force structure, making it more difficult to project power on a global scale. Thus, for example, United States forces in Europe will have shrunk dramatically. Sea transport will be the primary means of large-scale deployment, with satellite surveillance and space-based defense of sea lanes playing a crucial role, particularly in cases of conflict of long duration. In a future high-intensity war, it will be essential for the United States to have ASAT capability in order to execute deep and accurate strikes into enemy territory with precision non-nuclear weapons.

In high-intensity conflict U.S. forces must have sufficient firepower to deter or contain or even end the conflict in the early stages, before nuclear weapons are used. Firepower will be furnished by carrier-based support aircraft, strategic bombers, cruise missiles, and from long-range, land-based missiles. The force must have the ability to sustain combat and destroy enemy forces for a prolonged period. In order to be prepared for high-intensity conflict the United States must have a large inventory of air-, land- and sea-launched smart weapons because even by the year 2015 the defense industry will not be able to produce these technologically sophisticated weapons on short notice.

U.S. military scientists foresee the likely form of defense in a high-intensity conflict, such as that which might occur in Europe, to be that embodied in the concepts of AirLand Battle-Future. [17;8] In other words, the conflict will take place in a highly fluid battlefield, with an undiscernible front line, and operations will be non-linear. The depth and width of the battlefield will expand as new systems, such as the Army Tactical Missile System (ATACMS), are developed. The ATACMS will give corps commanders the ability to strike enemy formations over 100 kilometers away. Another system is the Joint Surveillance, Targeting and Reconnaissance System (JSTARS). It is important to note, however, that these systems may fall victim to cuts in defense spending as a result of the perceived lower threat from the Soviet Union.

### Mid-Intensity Conflict

This is another concept on the operational continuum of likely scenarios for the future. A mid-intensity conflict is a conventional war confined to one area of the globe and involves a regional power, rather than a superpower. The prototypical mid-intensity conflict has long been assumed to be that which would occur in Southwest Asia, and the recent war with Iraq has provided a concrete example. This mid-intensity conflict presented a considerable challenge for the United States because Iraq had high-technology weapons systems and in order to respond to threats posed by these systems the United States had to mobilize its assets over great distances. Iraq was the world's sixth largest army, with more than 1,000 tanks. Moreover, there was the added complication of having to gain support for the attack on Iraq from the other superpowers.

As a mid-intensity conflict, Operation Desert Storm served also as an example of the AirLand Battle doctrine in practice. Just as with the high-intensity conflict envisaged by military planners, the war

with Iraq required the United States and its allies to project power over a long distance and to employ its forces in a joint operations and combined arms mode. Laser-guided bombs enabled the allied forces to accurately strike the enemy at great distances. Most military planners see the success of the war against Iraq as proof of the efficacy of the AirLand Battle doctrine and thus as a justification for proceeding to the next stage--Airland Battle Future, which is fundamentally a refinement of the ALB. ALBF places a premium on mobility, agility, flexibility, and rapid movement. It posits a battlefield where there are fewer troops in more open formations, a less structured battlefield, where forces will rely even more than today on smart weapons that penetrate deep into the enemy's rear.

ALBF is more in keeping with the U.S. military's probable future mission of projecting land power to distant theaters as part of joint and combined forces. This projection of land power is the type of mission that will be required for mid-intensity conflicts, which some experts say will be the predominant form of conflict in the decades to come. The mission of U.S. forces in MIC has been described as "to engage and defeat traditional armies, navies and airforces of nations that choose to assault U.S. interests throughout the developing world." [8] It is a mission that will involve close interservice coordination, just as occurred in Operation Desert Storm because U.S. forces will be operating far from home and will also most likely be outnumbered. This situation does not mean, however, that the United States can be expected to intervene in mid-intensity wars whenever its interests are threatened. It is quite possible that by the year 2015 there will be so many constraints on the U.S. defense budget that it will have to be highly selective about global military commitments.

### **Low-Intensity Conflict**

Although it is generally agreed that mid-intensity conflicts are more likely to occur in the future than high-intensity conflicts, some military thinkers, such as Martin van Creveld and Rod Paschall, predict that the next century will not see any type of conventional warfare. They argue that such conventional forms of battle will have become obsolete, along with nuclear war, and that the predominant form of conflict will be so-called low-intensity conflict (LIC). Military theorists define LIC in somewhat different ways, but it is generally accepted as conflict at the lowest level of the operational continuum. According to Rod Paschall, low intensity conflict is armed conflict for political purposes short of combat between regularly organized forces. [20] Although LIC typically does not involve regular armies on both sides, it could involve a conventional army on one side and guerilla forces on the other. The term first appeared in the 1980s and has been used to describe several previous U.S. engagements, including those that occurred in Lebanon, Grenada, Iran, Panama, El Salvador, the Philippines, and Libya. Van Creveld also classifies the war in Vietnam as an LIC. [21] LICs tend to erupt in less developed parts of the world and they are often very bloody and protracted. Some experts define LIC in broader terms, as involving six areas: peacetime contingency operations, peacekeeping operations, combating terrorism, counternarcotics operations, counterinsurgency, and insurgency.

LIC usually involves special operations forces, those military or naval elements that are trained

and equipped to conduct or support insurgency, sabotage, psychological operations, counter-terrorism, and commando-type operations. They also perform rescue, reconnaissance, and intelligence-gathering functions. Although part of the armed forces, they are not designed for regular combat. These forces played a crucial role in the war with Iraq, although of course, this was a mid-intensity conflict rather than an LIC. Operating deep within the country, they disrupted internal communications and located scud missile launchers so that they could be destroyed by allied forces. Special forces will become even more important in the future, playing a role in military operations of all levels of intensity.

Paschall predicts a substantial increase in special operations forces in the early part of the next century, as well as unprecedeted levels of performance as a result of technological advances and better training. On balance, he observes, technological trends are favoring the terrorist, the special operations unit, and the insurgent as the 21st century approaches. First of all, trends in the world's industries will make them more vulnerable to sabotage and terrorism. We can expect to see larger nuclear power plants, telecommunications centers, and manufacturing facilities for pesticides and toxic chemicals. Airplanes will most likely increase considerably in terms of passenger capacity. Secondly, the greater effectiveness of new items that a human can carry or wear -- shoulder-fired weapons, rations, communications equipment and terrorist devices -- and the fact that manned war machines are becoming prohibitively expensive to produce favors the terrorist or insurgent. Paschall portrays a future world where men who stand on the ground with weapons in their hands defeat mechanized armies. [20]

Paschall and others see an end to the essentially bi-polar geopolitical world by 2015, a development which should reduce super-power tension. War will still occur, but it will take place primarily in the Third World and will most likely be low-intensity conflict. Insurgent movements--often based on urban underground movements--will be the prime instigators of LICs, but they may draw in the super-powers. The potential for United States involvement will escalate correspondingly as diverse forces--religion, nationalism, hunger, population growth, scarce resources--erode the ability of Third-World states to govern. Also, Third-World-sponsored terrorist attacks against westerners will increase, and, according to another source, counter-narcotics operations will become increasingly important. [1]

Before Operation Desert Storm, van Creveld went much further, arguing that conventional warfare is on its way out because modern weapons are becoming so dependent on complex technology for maintenance and logistic support and so big, expensive, and unmaneuverable that contemporary war is becoming a less viable alternative. Conventional wars depend on stable governments and their armies, but it will be increasingly difficult for states to retain a monopoly on violence, largely because of the growth of terrorism and insurgency, which threatens directly the viability of the state. As van Creveld describes it, states will gradually and spasmodically lose their monopoly on armed violence and will be confronted with widespread outbreaks of unrest and violent upheavals, similar to those that occurred in Europe during the Reformation. Distinctions between war and crime, soldiers and civilians will no longer exist. The first to be affected will be states in Asia, Africa, the Caribbean, and Latin America, but larger entities like the Soviet Union, China and India will also be affected by this process.

Van Creveld describes a world where by 2015, battles will be replaced by skirmishes, bombings,

and massacres, and military bases will be replaced by hideouts and dumps. "The spread of sporadic, small-scale war," he claims, "will cause regular armed forces themselves to change form, shrink in size, and wither away...much of the day-to-day burden of defending society against the threat of low intensity conflict will be transferred to the booming security business." [21] Surveillance technology will not necessarily be able to suppress subversion and LIC. Van Creveld argues that information-recording and transmitting equipment used to bolster a regime can be equally handy in subverting it and that devices declared tamper-proof by their manufacturers will still be tampered with. Subversion, therefore, will become a major problem for both Western and Third World governments.

## **IMPACT OF TECHNOLOGY**

### **Conventional Warfare**

Technological developments will have a tremendous impact on military science in the future, even if investment in defense technology is curtailed because of budgetary constraints. New technology will not necessarily change the nature of war, but in many significant ways it will change the battlefield on which war will be waged. There will be several areas where machines will replace personnel on the battlefield by the year 2015. Thus, for example, there will be unmanned "tel-operated" vehicles, remotely controlled at a safer location, that carry surveillance sensors or weapons into areas too dangerous for humans. Robotic machines, which are stronger and faster than humans and do not tire or require food or water, will replace human crew members to perform such tasks as loading ammunition in howitzers and tanks. By 2015 robotic machines could well play such military roles as reconnaissance, urban warfare, anti-armor attack, minefield sweeping, warning and monitoring logistics, sentry duty and explosive-ordnance disposal. [28] Given the fact the the United States and several other Western governments are now actively pursuing research in this area, we might expect extensive military application of robotics in the future.

As part of a trend towards greater automation of warfare, the microprocessor will deploy smart weapons on a more comprehensive scale. Computers will continue to replace human intervention and there will be more automated, long-distance decisions. The battlefield of the future will be fully computerized. Advances in computer architecture and machine intelligence will have reached the point where weapons will have the ability to analyze their environment and current battle situation, search likely target areas, detect and analyze targets, make attack decisions, select and dispense munitions and report results.

The U.S. military is at present on the verge of a revolution in conventional combat capability and soon will have long-range strike systems that can kill hard mobile targets, with delivery systems that are either air- or surface-launched and either launch-and-leave or man-in-the-loop. The combination of high survivability and the massing of lethal firepower will make such weapons dominant in most battle

situations. As one source points out, "The fusing of advanced sensors with brilliant weapons and battlefield management systems will bring a technological revolution on the battlefields of the next century." [8] One question that arises is whether, as some predict, these new technologies will restore supremacy to the defensive and mark the end of the tank's importance or whether these technologies will place a premium on rapid, stealthy action, and offensive operations. Most experts agree, however, that conventional warfare will be increasingly global in scope because of the technological sophistication and range of future weapons.

### The Nuclear Arena

SDI, the Strategic Defense Initiative, could put the defense against nuclear weapons completely in the hands of technology. Military experts are still arguing about whether SDI is feasible and cost-effective, and the final word may not come for some time. Some say that it is unthinkable for the United States to deploy such a system because it would be totally automatic, vulnerable to counter-measures and have to perform completely flawlessly, which might be a problem since its elements might be on-orbit for years before use. One computer expert claims, "Computer simulation of global nuclear war will never be accurate enough for us to design a shield against nuclear weapons because we simply do not know enough about what might happen in such a conflict." [23] But others, including Defense Secretary Cheney, disagree. Cheney is optimistic about the future of SDI, noting that systems under development, such as Brilliant Pebble (a missile interceptor deployed in a low space orbit) could make a missile attack on the United States too difficult for any enemy to risk in the future [3].

### Space

Although military applications of space have traditionally focused on strategic intelligence gathering and nuclear deterrence, there is a growing trend towards providing space support for conventional military operations. With the decline of the nuclear threat from the Soviet Union, we might expect this trend to continue in the 21st century. Space support will serve as a means of providing a rapid, reliable warning of regional conflagration, along with a rapid response. Space will most likely be the "high ground of conventional combat," providing rapid communications and being base independent. Supercomputers aboard satellites, which are less vulnerable to communications interference, will enable the U.S. military to have self-reliant reconnaissance satellites that can choose their own targets in that case where ground-based systems are knocked out in a war. Artificial intelligence techniques will permit automatic identification of objects in satellite photos--as a result of the development of high-speed, integrated circuitry, which will enable spy satellites to carry on-board computers that perform the bulk of image-processing before the data is beamed to the ground. Computerized surveillance will continue to diminish the possibility of surprise attack. For navigation, U.S. naval forces will have a global

navigation system of unprecedented accuracy. In the early 21st century, a wide range of communications satellite communications will be supporting conventional forces.

One issue that will become important to U.S. military science is that of extending the battlefield itself into space. Space offers the perspective to locate and track potential enemy targets and to support their engagement. Basically there are three types of space-related fire support that might be developed in the future: surface-to-space weapon systems (ground-based lasers or ground-launched antisatellite missiles); space-to-space weapons systems (killer satellites); and space-to-surface weapons systems (space-based laser or orbiting missile/projectile launch platform). [10] It clearly is not beyond the realm of technological possibility, but military planners have thus far shown little enthusiasm for using space systems for purposes beyond defense and surveillance and reconnaissance. A key consideration here is of course the vast cost of developing the technology for space warfare. The deployment and use of weapon systems in space is a very sensitive issue because of the time, resources, and effort required. Thus extending the battlefield into space will depend heavily on economic factors.

## TRAINING AND COMMAND

### Manpower and Force Structure

By the year 2015 the advanced technology of the U.S. military will provide the maximum warfighting potential from less manpower. A smaller, home-based, highly professional army will be the order of the day. Defense Secretary Richard Cheney has stressed that force levels envisioned by him and other planners for the Pentagon's long-range strategy represent "an absolute rock-bottom minimum." [3] Pressures to reduce the size of U.S. forces will continue well into the next decades. Force levels could be down by one third to one half by the year 2015. This condition means that recruitment will be geared to attracting young men and women with the high qualities necessary to perform efficiently and to grasp the new military technologies. Reducing the force levels should give the U.S. military the opportunity to be selective and to offer an attractive career package to prospective recruits. Given the changing ethnic composition of the U.S. population, the pool from which recruits will be taken will be composed of a much higher proportion of blacks and Hispanics than is the case currently. Women will continue to increase proportionately as a component of the armed forces.

Assuming that U.S. military science will continue to adhere to the doctrine of AirLand Battle Future in 2015, the army will have three types of forces: 1) forward-deployed and contingency forces 2) strategic reserve forces and 3) mobilization forces. The latter is the force required to win a major world conflict and consists of units that exist only in force planning documents. In accordance with the ALBF doctrine, these forces would be supplemented by allied troops. It is unlikely that in the future the United States will have a contingency force large enough to sustain more than one deployed contingency corps. This means that the reserve forces must be prepared to reinforce larger contingency operations.

Most experts agree that the force readiness requirement will not be fulfilled by the active forces. It does not follow, however, that the reserve forces should be structured to fight and win in all types of intensity combat, including special operations. The reserve capabilities in the future should be focused on those areas where the United States has a comparative advantage, such as fire support intelligence/electronic warfare, and command and control.

Because the United States will not be able to maintain large, specialized forces for every geographical area and type of combat, the army of 2015, according to one recent study, must be versatile, deployable, and lethal to fulfill its strategic roles. [15] Versatility includes "the right mix of active, reserve, heavy, light, and special operations forces, sustainment stocks and, above all, high quality in all aspects of the force." [15] Because of U.S. interests around the world and its coalition-based strategy, U.S. units will be required to deploy often with little warning time. The army of the future must be lethal in order to defeat the enemy as quickly as possible. This will require, above all, an army trained for combat readiness, which means that the army must support and maintain tough, realistic training programs.

### **Command and Control**

Judging from current trends, it might be expected that the pattern of command and control that was established by the Goldwater-Nichols act, which gives the commanders in the field much greater authority and stresses cooperation among the services, will continue. This trend will be promoted by technological developments and by force structures--the leaner, better equipped military force of the future will lend itself to a more stream-lined command and control system and better interservice coordination. And the logistics of command and control on the battlefield will be much more technologically sophisticated. Conversely, the growing range and accuracy of many weapons systems will continue to bring sea, air, and land battles closer together, raising the requirements for coordination of the services and the integration of command and control.

The projected increase in reconnaissance, surveillance, and target acquisition capabilities will raise the demands on command, control, and communications considerably, regardless of the level of intensity of the conflict. The battlefield of the future will be much more complex. Commanders and their staffs will have to be much better prepared to handle vastly increased quantities of data and information. If, as some analysts predict, future battlefields will be characterized by separate units fighting smaller, independent battles, this will impose even greater demands on the command and control systems. [18] There might also be a greater tension between the centralization that will characterize command and control at the higher levels and the decentralization that will exist in future battlefields. Another problem that might arise is that, despite immense progress in creating multiple forms of communication and in improving resistance to jamming and hardening command sites, the C3 system will continue to be vulnerable. Dependence on communication satellites will increase that vulnerability. Also, the problem of communications among allies on future battlefields will continue to create difficulties, particularly as

technologies become more diverse and numerous. In short, command and control on the battlefield of the future, where complex communications channels must be integrated and coordinated, will present continued challenges.

## TRENDS AND FINDINGS

Military science by the year 2015 will be heavily influenced by the geopolitical, technological, economic, and social changes that will have taken place. If present trends continue, the United States will not become isolationist. On the contrary, the increasing globalization of problems and issues will draw the United States into an array of interregional and international alignments created for dealing with environmental, economic, and military challenges. Competition of course will continue, particularly in technological, economic and defense spheres. But there will be a growing perception in the United States and the Western world of the need for widespread cooperation on a wide range of issues.

Military science will be closely coordinated with other geopolitical concerns. Defense experts will no longer be thinking primarily in terms of military superiority and military victory, but also in terms of political, environmental, and economic consequences of military operations. The legacy of the war with Iraq, which has resulted in unforeseen environmental, political, and societal consequences, could well mark the beginning of an era where military decisions are circumscribed by non-military concerns more than ever before. Domestic pressures, such as budgetary constraints and environmental considerations, will press the U.S. military further in this direction.

United States military policy will still rest on a power projection mission, and superiority in technological advances will ensure that the United States remains a superpower. But the old bi-polar concepts will have long been discarded, and technology will also have altered the balance of power and the nature of the perceived threat. Smaller countries, particularly those with unstable governments and nuclear or chemical weapons, will pose growing challenges. Even the third-rate powers will have weapons of unlimited reach and lethality. Terrorism and insurgency will give rise to more involvement by the U.S. military in LICs. Military science will no longer be preoccupied with scenarios for nuclear or high-intensity, global warfare, but rather with regional, less intense conflicts.

Arms control will continue to have a crucial impact on U.S. military science and defense policymaking. Despite setbacks that have recently occurred in negotiations between the Soviet Union and the United States, in the longer term we will probably see substantial cuts in the nuclear arsenals of both superpowers. Hard choices will have to be made by both the United States and the Soviet Union in deciding what weapons systems will have priority because both will be making decisions under the pressure of budgetary constraints. More attention will be devoted to preventing smaller governments from acquiring nuclear weapons. As one expert observed "it is highly likely that the major powers will cooperate more and more to damp down dangers they see in regions of the world where their interests may be threatened." [25] By 2015 nuclear proliferation could be seen as the foremost threat facing the world, in which case arms-control agreements will be the key to protecting the political and economic

interests of the United States. It is also possible, however, that conflict will be taking place outside the arena of governments and will have shifted to the low-intensity variety. This prospect will give major powers even more cause to pool their resources and influence in the interests of regional and global security.

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## KEY JUDGMENTS

### GEOPOLITICS AND THREAT

— The post-World War II bi-polar world is fast disappearing. The conditions that obtained at the end of 1945, exaggerating the pre-eminence of two powers, have virtually disappeared with the end of Cold War bloc confrontation.

— Europe will no longer be the center of political interest between the nuclear powers. Former "client" states, most of which are located in the developing world, are well-armed and equipped, and may pose security threats to the developed world. These potential regional hegemons will feel free to pursue their own goals. Recognizing that ideology, religion, and territory still play significant roles in relations between countries, the world is entering upon a very unsettled time. The world's hierarchy of nations will be challenged.

— The relationship between a nation's military power and its economy is being re-evaluated. Whether it will be possible to be an economic power without translating that into military/political muscle will be a question of debate for coming decades.

— The massive use of nuclear-based military force is becoming obsolete. Nuclear weapons have served to stabilize the boundaries in Europe. The entrenchment of interest in preserving postwar prosperity can balance the deterrent effect of World War II memories.

— The concepts of geography and territory are taking on new, nontraditional meanings. Geographical features are no longer an impediment to an attacking opponent because of modern weapons delivery systems. Transnational or global issues are emerging that know no state boundaries: global pollution and environmental degradation (nuclear accidents and oil spills) transcend national borders.

— The interdependence of world economies and markets is intensifying and leading to further decentralization. This greater interdependence is bringing closer coordination between nation-states. The information technology revolution is enhancing and enlarging the role of individuals in world and national affairs. Remote villages can view the world scene.

— There is a definite shift to the Pacific Rim and away from Europe. The Asian-Pacific Rim is America's largest export market. The security threat to the United States is not present in Europe. The potential for security concerns in the Pacific Rim area is high: the Korean peninsula is not stable, China will modernize its military, Japan is vulnerable to changes in the international trading economy, and Indonesia is not socially or politically stable.

— Two powerful trends are demography and technology, each driving the other. The developed world, the "North," is graying: its population is getting older and its fertility rate is dropping. The developing world, the "South," is young and growing very fast. Great pressure is being exerted on

the North through intense migration: into the United States from Central and South America and into Europe from North Africa and the Middle East. This pressure is altering the cultures and creating stress in the North.

— In the year 2015 the United States will go to war to protect its economic interests and to assist its friends. It will need to have highly mobile armed forces, well-equipped with high-technology weaponry. Forces will need to have theater-specific capabilities and be able to respond quickly to perceived threats to American interests. Those threats will be primarily economic in nature: threats to markets and natural resources.

## GEOPOLITICS AND THREAT IN 2015

The course of politics is the product of two sets of forces, impelling and guiding. The impetus is from the past, in the history imbedded in a people's character and tradition. The present guides the movement by economic wants and geographical opportunities. Statesmen and diplomatists succeed and fail pretty much as they recognize the irresistible power of these forces.

--Sir Halford Mackinder, 1890

The fog of peace appears to have taken over from the fog of war.

--John Roper,  
"Shaping Strategy without the Threat,"  
1990, [25]

We live in a time when geopolitics is being shaped by geoeconomics.

--Richard Solomon,  
Assistant Secretary of State for Asian Affairs, 1990 [12]

## INTRODUCTION

Geopolitics is the study of the geography of relations between the wielders of power. Power refers to the military, economic, and technological capabilities of states. The limiting condition of relations between states is war: the primary reason for going to war has been to command more territory. The greatest threat is not the clash of ideologies but the collision of forces over some piece of land. Mackinder's comment sums up the history of international relations: the recurring struggle for wealth (read: economic surplus) and power is among actors who are confronted by the dilemma of the uneven distribution of natural riches. How a state reacts to this circumstance is determined by its unique historical development. When economic surplus was based on agricultural output and technological development was slow or nonexistent, the amount of economic surplus was fixed to the amount of land which could be tilled and the number of laborers who worked it. Historically, the course to higher surplus and greater power has been war: one actor took from his neighbor the riches (read: land and laborers) needed to increase economic surplus, thereby enhancing his power and authority in the world system. In this scheme, geography is the central fact of world politics. The geographer emphasizes the defense that geography offers against the ambitions of rivals. [23] Even with the advent of industrial economies and rapid technological development, geopoliticians still analyze international relations in terms of territoriality.

But geopolitics is only one way of analyzing the relations between peoples and nation-states.

Many now believe that a new era has dawned in which the use of military force has been reduced in efficacy and that peaceful evolution has replaced military conflict in adjusting relations between states. These analysts maintain that domestic economic and welfare goals have triumphed over the traditional power and security objectives of nation-states. They see a world that has become so interdependent because of technological advances in information processing and international trade that the nation-state system, dominant since the Treaty of Westphalia ended the Thirty Years War in 1648, has become obsolete.

Another group holds that the nation-state system is still strong and long-lasting and that national security and power remain primary state objectives. They recognize, however, that the theory enunciated by Mackinder in 1904 in "The Geographical Pivot of History," no longer has its original potency because of the development of modern weapons of mass destruction. Since 1945 the political significance of the geographical configuration of continents and oceans is no longer relevant because it has become possible to project terrific firepower over great distances without conquering strategic land or dominating strategically located seas and oceans. [28]

The objective of this study is to determine potential threats to the security of the United States and to project the various circumstances under which the United States will go to war in the year 2015. This will be done through the identification and analysis of trends in world politics and the international system and by pinpointing those factors that will effect changes in those trends, the so-called "change drivers." Finally, the study focuses on the implications of these trends for the United States Army in order to assist the military in meeting whatever threat may present itself to the nation.

## **IDENTIFICATION OF TRENDS**

This study identifies four trends continuing into the next century:

1. The post-World War II bi-polar world is fast disappearing.
2. The massive use of nuclear-based military force is becoming obsolete.
3. The concepts of geography and territory are taking on new, nontraditional meanings.
4. The interdependence of world economies and markets is intensifying and leading to further decentralization.

The analysis of these trends and the factors which may intensify or alter their development (the "change drivers") will lead to a projection of future scenarios for possible geopolitical developments.

### **1. The post-World War II bi-polar world is fast disappearing.**

Americans became aware of geopolitics in December 1941. The historical isolationist pattern of American policy, namely, to stay home and tend to business and let the Old World have its squabbles, even after World War I, ended with the bombing of Pearl Harbor. Americans understood with immediate

clarity that the oceans could no longer protect them from events occurring in other areas of the world. The writings of Sir Halford Mackinder were known only to professional geographers before 1941, but he became a household name as American involvement in the war continued.

Mackinder's "Heartland" theory and Karl Haushofer's geographical determinism, which formed the theoretical underpinning to Hitler's march to the east, ultimately became the foundation for American postwar policy for a bi-polar world: containment of the USSR. When this policy was enunciated in 1947 the worst was yet to come: the Communist Revolution in China. The Mackinder nightmare came to life as the Eurasian land mass was united for the first time in modern history under the same ideological flag. The greatest land power on the globe commanded the greatest natural fortress on earth.

The American reaction to this development was "containment": confront the Russians at any point where they might gain influence. This has been the central policy of the United States for the last forty-four years. This policy has been successful and has provided the framework for the development of a strong worldwide free market economy. The essential contribution by the United States to the interdependent world economic picture has been the creation and enforcement of rules protecting private property rights. Property rights are a set of economic and social relations among industries defining the position of each industry with respect to utilization of scarce resources. [31] The nation-state is the only actor capable of establishing stable property rights.

Each power formed its own bloc, and the world was effectively divided into two ideological camps. The Cold War ensued. Given the changes in the relationship between the two powers in the past year, it is clear that the bi-polarity of the international system is in flux. The Warsaw Pact has been dissolved, and the economic crisis in the Soviet Union has caused that nation to discontinue its support for its allies and client-states and withdraw from "foreign adventures" to concentrate on its own domestic ills.

Robert Gilpin defines the international system as the aggregate of diverse entities united by regulated interaction according to a form of control (for example, imperial/hegemonic, bi-polar, and balance-of-power). [10] Despite the anarchic nature of the system (there is no formal global government), there is a high degree of order among states because the system exercises an element of control over behavior: it rests on the distribution of power among political coalitions -- it determines who governs and whose interests are to be promoted. Throughout history the periods of relative peace and stability are those in which the prestige hierarchy has been clearly understood and unchallenged. The post-1945 era is such a period: the two powers have rarely challenged each other directly to the point of full-scale war. Nuclear weapons have essentially rendered such war obsolete: to date neither side has been able to figure out how to use them without global annihilation.

The disappearance of the bi-polar world presages two developments. One, as a consequence of the collapse of the Warsaw Pact and the reunification of Germany, Europe will no longer be the center of political interest between the nuclear powers. Many analysts have written about the end of the Cold War or have speculated about the "end of history." Because the nuclear powers are no longer consistently at odds and are cooperating in international arenas, their "client states," promoted and armed by both sides,

have been left with significant amounts of weaponry and are free to pursue their own regional hegemonic goals. Recognizing that ideology, religion, and territory still play significant roles in the relations between countries, analysts believe the world is entering upon a very unsettled time. The hierarchy will be challenged by these would-be regional hegemons.

The second development growing out of the disappearance of the bipolar world is a reevaluation of the relationship between a nation's economy and its military power. The Soviet Union is perceived to be a one-dimensional superpower (its superpower status is based primarily on its possession of a nuclear arsenal without the economic strength to support itself). Some analysts believe it is possible to be a world power on the basis of economic power alone. Germany and Japan are held as two examples of this phenomenon. Both nations play major roles in the economies of other Western countries and soon will do the same in the former East Bloc. While it is widely recognized that both countries could become military powers if they chose to do so and much of the prestige they garner is based on that understanding, it must be recognized that economic power can play the role it does because the economic and political order was created and defended militarily by the United States.

The changing world economy is producing regional powers. In the East Asian region, widely recognized as one of the fastest growing economic areas, the combined GNP of Japan, China, South Korea, and Taiwan will be greater than that of the United States in 2015. China's GNP will exceed that of the USSR in the same period. The European Economic Community (EEC), scheduled for market unification in 1992, will have a combined GNP double that of the USSR by 2015. India's GNP will equal France's, and Brazil's will equal that of the United Kingdom (see Fig. 1).

To date, China has put off military modernization, but it will undertake such a program within the forecast period. The emerging regional powers (South Korea, Taiwan, Turkey, India, Brazil, Egypt) will have formidable stacks of weapons and possible advanced systems. The economic development of these newly industrialized nations will tend to diffuse power more widely.

The United States continues to wield great economic clout through international structures it created in the post-World War II period, but its own fiscal difficulties have caused many at home and abroad to question the longevity of that economic force. Some analysts believe that America's hegemony will be limited to no more than the decade of the 1990s. As a result of the end of the Cold War, the indefinite continuation of the post-World War II alignment that exaggerated the hegemony of the United States and the Soviet Union, each within its own sphere, is improbable. The further development of alternative power bases leading to the appearance of a multi-polar world is the likely trend.

## GROSS NATIONAL PRODUCTS (BILLIONS OF 1986 DOLLARS)

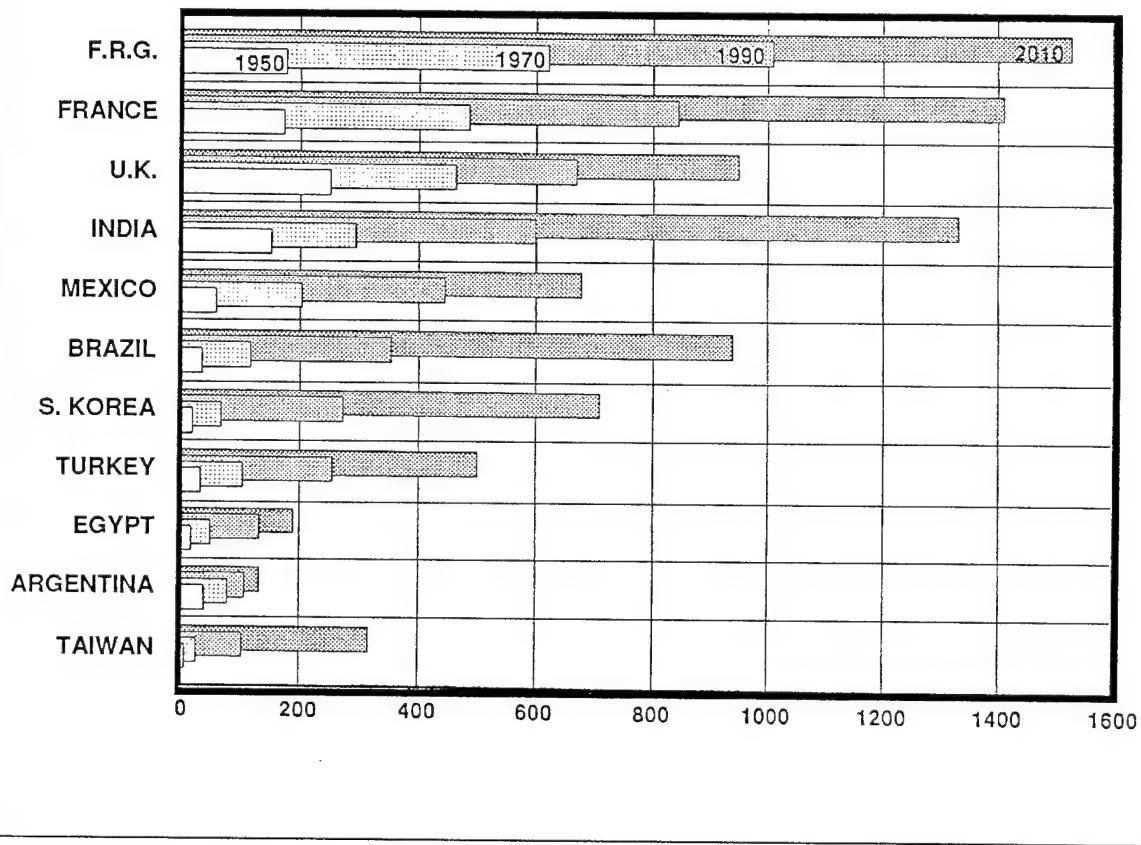


Fig. 1

**CHANGE DRIVER:** a) If the current trend toward decentralization of power in the Soviet Union does not continue and the CPSU and KGB remain entrenched in power, then the primary strategic interest of the United States-led Western alliance will continue to be focused there. Despite its domestic economic and political turmoil, the Soviet Union will continue to be in competition with the United States in the future both because of the size of its past investments in military technology and because of its position at the leading edge of military technology. But with authority continuing to be centralized in the Party and bureaucracy (*nomenklatura*), development of the economically driven multi-polar world would be retarded: nuclear hegemony of the two rival blocs would remain primary. A Cold War scenario would resume in which arms control and nuclear sufficiency would remain pillars of strategy. The Soviets could produce alternative patterns, however. These could include a reduction in military expenditures in favor of capital investment reducing the threat to U.S. security, or there could be merely a restraint of growth in military expenditures, in which case research and development would continue and production could be instituted at a later date (see Fig. 2). [9]

b) If the Soviet Union reconfigures into a confederation of nine republics (with Estonia, Latvia, Lithuania, the Ukraine, Georgia, and Armenia becoming independent) and the command-and-administer style economy is eliminated in favor of a modified free market system, then a multi-polar global system will accelerate multi-polar development.

c) If some nations of Eastern Europe are unable to make the transition from command economies to market systems and popular unrest and fears of anarchy mount, then dictatorships will be re-installed that will be potentially hostile to American and Western interests. This scenario would be the so-called "Peronist" alternative: a market-adaptable economy with strongly centralized authority. While nationalistic and opposed to old-style Soviet hegemony, philosophically they would be non-aligned.

## 2. The massive use of nuclear-based military force is becoming obsolete.

Conventional wisdom has it that nuclear weapons have become unusable: such weapons are for mass suicide. Martin van Creveld has said that the United States and the Soviet Union have, in effect, been "debellicized." [8] It is widely recognized that political advancement from the possession of nuclear weaponry has been null: being the sole possessor of nuclear power did not enable the United States to keep Eastern Europe out of the Soviet sphere of control, nor did it enable the United States to prevent the Communist Revolution in China. China still does not have Taiwan despite its nuclear capability. Nor has its entry into the nuclear club enabled India to have its way in Sri Lanka, where civil strife continues.

Nuclear weapons have served to stabilize the borders in Europe, the primary area of superpower interest. Conflicts between the two powers since 1962 have occurred exclusively at the periphery of superpower interests (i.e., outside Europe). The credibility of deterrence in Europe had to do with the network of economic and political interests, cultural and institutional ties, and past commitments that existed between each superpower and its group of European allies. The prospective levels of casualties

and property damage from conventional warfare alone was an enormously powerful deterrent. "If the deterrent effect of World War II memories has faded slightly, the entrenchment of interest in preserving postwar prosperity can balance it." [27,p.187]

But the statement "everyone knows that nuclear weapons cannot be used" does not make it a fact: "everyone" may not know it! There are other nations seeking the status and prestige that nuclear weapons confer, and they may not refrain from using them. Other members of the "nuclear club", not necessarily self-acknowledged members, such as Israel, Pakistan, South Africa, Argentina, Brazil, and perhaps North Korea, have serious border disputes with their neighbors on what may be considered "fault lines" of conflict. One cannot assume that nuclear weaponry will not be used in the future.

If, however, one assumes that the use of massive force is not as powerful an option, the question arises about the type of force that would be used in its place. Martin van Creveld believes that conventional warfare will cede its position to low-intensity conflict (LIC). LIC is defined as having the following characteristics: it unfolds in less-developed areas (LICs in the developed world are called "terrorism", or "police actions"); the participants are normally guerillas, rarely regular army combat soldiers; it relies little on high-tech weaponry (although this may change in the future). [8] The kinds of conflicts the world sees in Lebanon, Cyprus, Angola, Mozambique, Ethiopia, El Salvador, and the Philippines are typical of LICs.

While we believe that LIC is very likely the more typical confrontation in the future, we do not rule out the use of massive forces in conventional theaters of operation. If a would-be regional hegemon, a charismatic leader, with large army and wealth of weaponry, comes upon the world scene not having learned from Saddam Hussein's mistakes and confronts a major power under the terms of conventional engagement, force will be used on a large scale.

## GROSS NATIONAL PRODUCT: US, USSR, AND CHINA

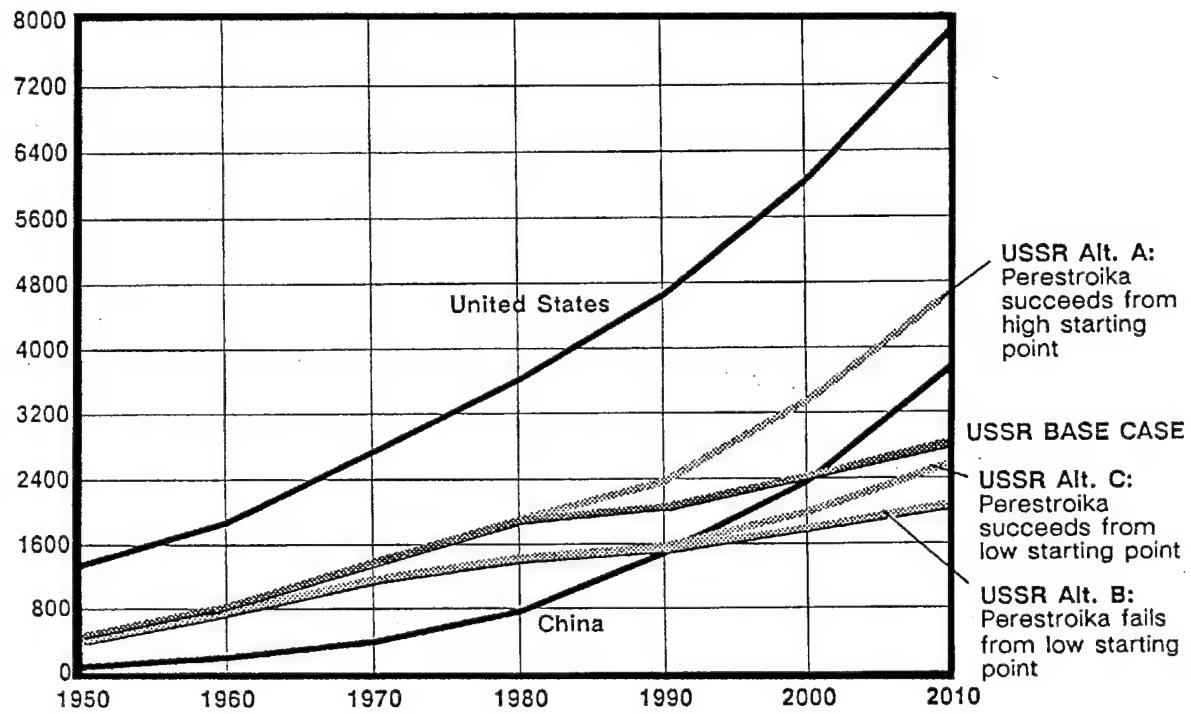


Fig. 2

**CHANGE DRIVER:** a) The potential for massive use of force will increase if ballistic missile capability proliferates to many more nation-states (reports of upwards of 25 to 30 such states have been published) and these states themselves have the technology to produce or acquire nuclear or chemical/biological warheads. Many of these states have border disputes or powerful ideological drives and hatreds to endanger international stability. Emerging regional powers (South Korea, Taiwan, Turkey, India, Brazil, and Egypt) have formidable stocks of weapons -- possibly advanced systems. They will not need superpower suppliers or approval to use them.

b) If a transnational governing body with authority to monitor and verify weapons destruction emerges and/or the sales of arms to Third World and developing countries ceases, then the potential for massive use of force further diminishes. If a modified and expanded COCOM is created with verification and enforcement provisions and member states abide by its rules and limits, then less-developed states will not easily acquire the technology of weapons of mass destruction. If the concept of verification becomes widely accepted (presently occurring in arms control talks between the superpowers), then there will be procedures to ensure that the technologies and weapons themselves are not produced. Arms control agreements between the nuclear powers will reduce current stockpiles, and signatures created for nonnuclear strategic capability (NNSC) weaponry to prevent nuclear retaliation "accidents" will reduce the likelihood that massive force will be used to settle disputes.

### **3. The concepts of geography and territory are taking on new, nontraditional meanings.**

Two concepts are at work in this trend. First, in geopolitical terms, the territorial boundaries of states no longer have traditional significance because of the development of weapons delivery systems: geographical features are no impediment to an attacking opponent. Therefore, the concept of security for a nation-state has changed dramatically. Second, transnational or global issues are emerging that know no state boundaries.

Many geopoliticians accept the fact that geography and geopolitical considerations are, if not irrelevant, at least unalterably changed by the developments in strategic nuclear technologies: the concept of geopolitical space has been modified. Whereas Pearl Harbor ended American "glorious isolation," the ICBMs of the 1950's added greater insecurity. When SLBMs were developed, the vertical parameters disappeared beneath the surface of the oceans as well: no nation-state could be isolated from global involvement anywhere. "The entirety of national territories is an open window." [33, p.144]

Another aspect of this concept of the changing understanding of what territory and geography mean is the emergence of transnational issues. Most people of the developed world have come to realize that there are events and issues that respect no national borders: air pollution from Ohio brings acid rain to Canada, emissions from power plants in Czechoslovakia and Poland are destroying the trees of the Black Forest in Germany, the AIDS epidemic has spread all across the world in less than a decade, the breakdown of the ozone layer, caused by global pollution, with potentially devastating environmental ramifications, will affect all life on the planet, and many other

issues. The government of the Soviet Union eventually admitted the nuclear meltdown at Chernobyl after irrefutable radiation readings in Sweden were made public. The struggle of the United States government to come to grips with the international drug trade illustrates the difficulty one government has in managing or controlling an issue that spans national borders. These issues transcend the limits of a single government's control: many domestic problems have an international component.

James Rosenau, author of a remarkable study of change in international relations entitled Turbulence in World Politics, has theorized that one of the most fundamental changes in the relations between nation-states is at the microlevel: the heightened competence of individuals. [26] This improved analytic power has come about through the telecommunications revolution: even remote villages in the underdeveloped world can receive television transmissions and see what is occurring on the other side of the globe. Individuals have increasingly come to understand that certain issues do not remain confined within the borders of a single nation-state.

Along with this development one sees individuals, coalescing in subgroups, moving away from larger governmental institutions. Because of increasing frustration at the inability of larger units to solve problems, individuals are forming into groups to make their collective voice heard. These groups can take the form of a "movement" (a loosely knit aggregate of like-minded individuals and organizations seeking to influence one or more aspects of human affairs), e.g. the "women's movement", the "ecology movement", or a "leaderless public" (the convergence of actions or orientations of large numbers of people with the absence of authority), e.g. polling groups, rioters. The public no longer believes that national governments can solve problems. The perceived lack of credibility on the part of larger organized units to solve dilemmas is leading to decentralization. "Decentralizing tendencies lead to the proliferation of boundary-spanning relationships, thereby undermining hierarchy and intensifying the volatility of global authority structures." [26,p.187]

**CHANGE DRIVERS:** **a)** The ability of subgroups to effect change in state policies will be an important factor in whether transnational issues come to dominate the international agenda. If the "interdependence" analysis proves correct, then the multi-centric world will aid the break down of the hegemonic international system currently dominated by the United States. The effective sovereignty of nation-states will be undermined because, as Rosenau has said, more and more interactions in world politics are unfolding without the direct involvement of nations or states. Symptoms of national loss of sovereignty are technological breakthroughs that circumvent national authority (Fax machines, PCs, telecommunications, "smart" terminals); authority crises that arise as individuals improve their analytical capabilities; consensus breakdowns that occur as subgroups emerge to voice their own agenda.

**b)** Some analysts have asserted that the "superpower" category is gone: if the rivalry is removed the category vanishes. The category of "great power" was associated with invulnerability. "Superpower" came into being with nuclear weaponry when it was no longer possible to be invulnerable. William Pfaff has written that superpower is not great power writ large, but a different category of power characterized by a nuclear arsenal by which each superpower rendered the other vulnerable. [24] If national boundaries

can be defended against ICBMs and SLBMs as they were in the pre-missile era, then the concept of invulnerability will have its traditional significance. Nation-state borders will have more meaning again with the development of the Strategic Defense Initiative (SDI) or some variation thereof. If offensive missile systems undergo significant reduction and verification measures are improved in the destruction of existing stockpiles, then nation-states having ICBM and SLBM capabilities may opt for defensive missile systems.

#### **4. The interdependence of world economies and markets is intensifying and leading to further decentralization.**

The post-World War II era of American hegemony has been termed the triumph of liberalism because the United States has provided the public goods necessary for the functioning of efficient world markets. [10] Adam Smith had argued that real wealth came from trade stemming from the exchange of goods, not territorial possession. In the 20th century, the United States has continued the enforcement of international rules protecting property rights that the United Kingdom created in the 19th century.

As a result of financial institutions (The World Bank, The International Monetary Fund) and trade agreements (GATT) that came into being after 1945, the world has seen unprecedented growth and economic development. The links between the world's economies become closer all the time: the nations of Western Europe are on the threshold of uniting their markets in 1992; the North American continent may become one trade zone that may eventually embrace the entire western hemisphere; the Japanese "Co-Prosperity Sphere" of the 1930's is seemingly a reality in the 1990's.

The greater interdependence of world economies and the emergence of transnational issues is bringing closer coordination between nation-states. At the same time decentralization is occurring. The need to deal with worldwide environmental pollution, currency crises, and terrorism impel greater cooperation between systems even as global television and communications networks, the information revolution, bring about decentralized "loci of action" enhancing the influence of subsystems and enlarging the role of citizens.

Individuals become frustrated when they witness the inability of central authority to confront issues and solve problems. Global communications media transmit images of authority being challenged elsewhere. Legitimacy and authority crises develop as locals grant legitimacy to leaders based on performance rather than on the grounds of historical respect for the office held. Authority is so decentralized that no system or cluster of systems has control over outcomes: individual citizens negotiate with terrorists for the release of hostages; gangs of criminals and terrorists deal with heads of state as co-equals. In the name of competitiveness, corporations are being internationalized to an even greater extent. United States companies abandon their national identities and say they are global, no longer dependent on the American economy. Trade is propelled by the lure of markets, not the flag. A recession at home, they say, does not impact operations abroad as it once did. There is a decoupling of the corporation from the country. [26]

**CHANGE DRIVERS:** a) A pronounced isolationist trend could produce a drive to close a nation-state's borders to outside "influences." One such case is Iran where, after the revolution, the Iranian Revolutionary Guards, drawing on Shiite fundamentalism, closed the country to prevent Western influence from "contaminating" the population. Such a religiously or ideologically based attempt at autarky could retard movement toward interdependence, although it is unlikely that a large number of countries would pursue such a course.

If, however, economic nationalism, always near the surface, should appear in several major economies or trading blocs (e.g. the EEC or Korea), then it would have significant impact on world interdependence. Moves to stifle importation of "luxury" goods or products that compete directly with favored domestic industries would be warning signals for such a condition. There could be attempts on the part of some states to "go it alone," especially if "outsiders" impose pressure on cultural patterns. Economic nationalism is possible, but it is outside the realm of the probable.

b) Developments in high technology, for example, the fiber-optic network, will accelerate interdependence through the spread of education programs, agricultural assistance, or worldwide weather forecasting. If ecological degradation of the planet continues, a likely prospect, then there will be a global attempt to deal with the disposal of waste products. Such a development would foster cooperation between nation-states.

These four trends are predicted to continue into the first decades of the 21st century. However, a careful examination will yield possible alternative developments. First, neither the United States nor the Soviet Union will be able to dominate the international system indefinitely, given post-1992 EEC market unification and the growing economic power of the Pacific Rim countries. Although the Cold War as defined by East-West bloc confrontation is over, the differences between the Soviet Union and the United States-led Western alliance will continue to drive many world issues: in the Persian Gulf region, in relations with the Islamic nations (because of the Soviets' own potentially restive Moslem population) and oil supply (the USSR may be a petroleum importer in the very near term), and in the Pacific, where the Soviets have made it clear they intend to be an "Asian power." (Consider President Gorbachev's Vladivostok speech 1986.) The desire of the Soviet Union to be a force in world politics has not diminished, and with its nuclear arsenal it cannot be disregarded as a major actor. The Soviet Union, even with the most positive of possible outcomes (i.e., a full-fledged democratic, decentralized confederation of states) will have interests different from those of the United States. While the introduction of market-economy reforms into the Soviet system is seen as a desirable goal, a less autarkic USSR challenging the United States in the world markets and competing for scarce resources could be destabilizing.

In the longer run (2005-2015), unless the Soviets can significantly relieve their economic difficulties and move toward a new period of substantial economic growth, they will gradually become less conspicuous in U.S. policy and strategy. Widely different developments are possible for the Soviet Union -- ranging from major reductions in Soviet active forces to free resources for economic revival, to persistent economic stagnation that constrains military modernization, to successful economic reform

that positions the Soviets to compete effectively with the United States in the military-technical revolution. [9]

John Roper's comment about the fog of peace is particularly appropriate when considering the disintegration of the bi-polar world of post-1945. In fact, the Cold War was relatively clear: the certainties were numerous. As John Mearsheimer has suggested, the move from bi-polarity to multipolarity is not guaranteed to enhance stability. During the Cold War, bi-polarity led to global caution, and regional conflicts were inhibited because of the risk of horizontal escalation. The diminution of bi-polarity may lead to a proliferation of local conflicts and local threats. [22]

It is important not to confuse the end of the Cold War with the elimination of warfare and the emergence of universal peace. Some regional wars have been short because of the inability to resupply weapons. If there is a proliferation of major supply centers that could change; there could be protracted, large-scale regional wars supplied by neither superpower. Brazil, Israel, South Korea, China, and India all produce weapons for other nations and could supply regional combatants or conflicts in which they themselves are involved. There were numerous serious armed conflicts during the Cold War period, and if anything, such types of conflicts promise to be more serious and more numerous with the absence of two controlling power blocs.

The multi-polar world is a turbulent one. By definition there will be more actors and interests to be served. There will be a questioning of the legitimacy of the existing power hierarchy. Because the possession of nuclear weapons enhances prestige and gives rank in the system, more countries will seek to develop them. It is for this reason that the major powers may very well decide to develop defensive missile systems to guard against a nuclear attack by a regional hegemon. Analysts believe that a system like SDI could be effective against a small nuclear force while not sufficient to deter a large nuclear arsenal.

What do these scenarios imply for the U.S. Army? First, to date, the evolution of various forms of global economic cooperation and interrelationships has not yielded the geopolitically secure relationships that would preclude substantial military force readiness in the name of national security. Long-term economic interdependency might encourage geopolitical evolution, but clearly the two processes move at very different speeds. The advent of new multinational economic blocs and the consolidation of others such as the EEC could have two effects. Driven partly by the degree of overall expansion and prosperity in world markets, these blocs may be the basis of geopolitical stability and a source of financial aid to the increasingly restless "have-not" South. The latter eventuality might forestall geopolitical conflict with members of the "have-not" group, generated by exacerbated economic disparities. Or economic rivalry for limited markets may degenerate into new geopolitical hostility among the "haves," negating the unifying effects of international communications networks and trade agreements. Obviously the first choice promises substantially greater national security for the United States than the second, however directly the United States might be involved in such economic/geopolitical blocs. A potential economic bloc with particular resonance for United States geopolitical planning would combine Japanese manufacturing and financial power with raw materials from the Soviet Union and perhaps China.

North-South issues could come to dominate the international agenda. The emergence of global ecological problems and limits to growth go far beyond individual states. There will need to be a universal commitment to a modern and better life for all inhabitants of the planet because the limits-to-growth approach may lead to bitter fights over scarce resources and to the carving up of the World Ocean. There is no guarantee that selfish concerns will be subordinated to the larger good. On the contrary, modern science and technology may intensify conflicts over resources.

Power centers will emerge with cultural and diplomatic traditions far different from the once-dominant West, and this fact may presage a return to conflicts of the premodern era. The European powers have attempted to bring the fruits of the "Enlightenment" to the "uncivilized" world for three centuries, believing it to be their "burden." "The notion of a unified humanity does not exist; it is the creation of a West trying to impose its values on a set of diverse cultures." [10, p.225] Political fragmentation will increase on the globe because humans are deeply divided by race, religion and wealth. Nationalism, with its roots in 17th century Europe, is a predominant faith of modern man, and it has unleashed powerful destructive forces.

The scenarios outlined here have other implications for the army. There is no certainty that the massive use of force will disappear. Merely because the nuclear weapons are deemed unusable by "rational" people and/or a defensive missile system is developed by those who have the technological capability and resources to build it, other types of massive force may replace nuclear weaponry, to wit: the nonnuclear strategic capability (NNSC). The application of NNSC to LICs is increasingly important. For strategic purposes such application is a significant development: it results in a war-widening option short of nuclear escalation.

It has been suggested by some analysts that U.S. and Soviet military competition is likely to focus increasingly on nonnuclear weapons. New types of explosive charges have been developed that can make these weapons as effective as small nuclear blasts against most military targets without many of the consequences associated with the use of nuclear weapons: precision-guided munitions, fuel-air explosives. This type of weapons technology need not remain limited to Soviet and U.S. forces only.

The widespread development of advanced technologies in the commercial sector for nondefense purposes has occurred. Many newly industrialized countries (NICs) are acquiring their own R&D capabilities. In addition, co-production schemes enable partners to acquire advanced technological processes. The United States cannot dominate military situations by exclusive ownership of an advanced technology. It is possible for countries to expand this nonmilitary technology into military applications.

Although Operation Desert Storm was perhaps an anomaly in terms of the massing of conventional arms, there is no assurance that similar events will not recur. Ongoing developments in technology may lead political figures to believe that massive use of force is possible without nuclear escalation.

While the concepts of geography and territory have acquired nontraditional values (because the industrial and technological basis of economic surplus obviates the need to seize a neighbor's territory and development of ICBMs and SLBMs has, in effect, opened the borders of all nations), the emergence

of transnational issues relating to ideology, religion, and ethnic origin makes territory a fundamental issue between nation-states.

Peoples all over the globe are in a whirl of change, and they are increasingly looking to their group identities: physical characteristics, name and language, history and origin, religion, and nationality. These identities frequently cross state boundaries, particularly if they are deemed the residue of the colonial era. Most of the boundaries were not based on where peoples actually lived, but were artificially drawn by the colonial powers for geopolitical purposes. These boundaries have generated the most conflicts. Examples of these issues and their link to territorial conflict include: the Arab world, where the historical concept of the "Arab Nation" has been used to justify the attempts by different leaders to unify the area; historical ties and ethnic unity were fundamental to the struggle of North Vietnam to conquer the South (the Korean peninsula is another case); the Shiite Imams and Mullahs in Iran have expressed the desire to unify the Moslem world. There are numerous other examples.

However, many of these conflicts are arising in places where nation-states have been "united" for centuries: Western Europe and North America. The weakening of the fabric of consent (the result of Rosenau's microlevel "increased cathectic capabilities of individuals" and the movement toward "subgroupism" leading to the questioning of legitimacy and authority) that had kept sub-national groups passive or submissive has unleashed long pent-up frustrations for linguistic, regional, political autonomy or a reassertion of cultural distinctiveness. The Scots and Welsh, residents of Ulster, Bretons, Corsicans, Flemish and Walloons, Basques, Catalans, and Quebecois are examples of this phenomenon. Many of these peoples are separated from their larger group by state boundaries; hence we see movements for independence within long-established nation-states. Centrifugal and centripetal forces are at work.

People everywhere are turning away from entire systems--the state, society, community--to smaller collectivities. It has been said that the nation-state is too small for the big problems of life and too big for the small problems of life. Whole systems are too complex for their needs and wants, and they seek to regain control by turning to subsystems. They hope to get in a place they feel they belong and where they are grouped with their own kind for physical and emotional safety. That group becomes "the nation." The nation is defined as the largest community that, when the chips are down, effectively commands men's loyalty. [16] The downside to this phenomenon is that the maintenance of basic consensus required for effective and democratic public action becomes more difficult if society divides into distinct and separate ethnic and cultural blocs. The capacity to mobilize the whole, or very nearly the whole, of society for a national cause (e.g., war) will become problematic or impossible if cultural diversity produces more cross-purposes and political deadlocks. [21]

Religion is one of the most powerful sources of community in the world today. A major sub-trend is the unsecularization of the world in the late 20th century. Religion is not going to fade from the scene. It is a Western conceit that religion is an irrational, premodern phenomenon; religion, however, is becoming a powerful force in the United States, Western and Eastern Europe, and the Soviet Union. Protestant evangelism is on the rise in traditional Roman Catholic Latin America (the recent election of an Evangelical Protestant to the Peruvian presidency bears witness to the power of the

movement). Religion serves as a dominant unifying force for many groups and is a transnational issue of significance. It need not be a divisive force. "We must discern the theological and political conditions under which religion can serve the cause of nonviolent conflict resolution." [32, p.27]

The growing interdependence of the world's economies does not necessarily guarantee peace. Economic welfare is said to replace national security as the principal object of societies: economic cooperation has displaced traditional conflict over territory, balance of power, the rational use of resources. We are said to be in an era of international cooperation. Some realist analysts, notably Kenneth Waltz, have argued that interdependence and global power are being confused. Transactions in and of themselves do not have any political significance. What counts is the ability of a state to adjust to change or to use its economic position for political leverage. However, nations are apprehensive about the loss of autonomy and access to foreign markets, and, as a result, economic nationalism is a potentially disruptive force in the interdependent global economy. Some have seen the rising tension between the contrary pulls of the global economy and the national polities as a structural problem. Capital can flow easily; people cannot. No national government today controls its own capital flows to take advantage of differential interest rates, cheaper labor, and better investment opportunities. But people cannot move as readily nor are many countries prepared to take them. As jobs slip away, the government must move to protect either capital or people. A large economy may be able to manage these transitions but many cannot, and fragmentation because of economic difficulties, multiplied by ethnic clashes, increases the chances for LICs. [3]

While recent decades have seen the growing interdependence of national economies--and this trend is predicted to continue--there will need to be a focus on those economies that have not participated in the exchange. William McNeill has written,

Resistance to immiseration has become far more vigorous in recent decades because new forms of communication have penetrated even remote villages. Subsistence farmers, who in a previous generation encountered outsiders only rarely and as strangers, find a new world opening before them when radio and TV programs begin to flood into the village square or their homes...Pushed by intensifying land shortages at home and pulled by the charm of urban comforts as revealed by the new communications, peasant populations are ready, as never before, to claim the rights of full citizenship and equality of circumstances. [21, p. 187]

These developments demand new strategies from the United States.

## THE UNITED STATES AND STRATEGIC THINKING

"Because it is rooted in geopolitical soil, the character of a country's national security policy tends to show great continuity over time, though there can be cyclical patterns of change." [14, 15] The United States will go to war in 2015 for the same reasons it has always gone to war: threats to its commercial interests and trading power combined with its strong "moralist" bent.

Geopolitics relates international political power to the geographical setting. It embraces human and cultural factors as well as the statistics of territory, economic assets, and distances between political enemies. "The cultural thoughtways of a nation are the product of geography." [14] To understand American geopolitical thinking requires an understanding of American history and its geographical perspective.

United States geography lends an insular perspective on international politics. The founding of the nation came about through the desire to escape "Old World" entanglements. The dread of entangling alliances was a natural development of that founding. The nation succeeded in pursuing that strategy until World War I when the balance-of-power system in Europe broke down over the inability to contain a unified Germany. The exclusively European character of the system was destroyed by the need for American assistance: the United States replaced the United Kingdom as the necessary balancer.

At the conclusion of that war, the United States promptly returned to its historical isolationist position. Why? There are five broad characteristics of "the American Way":

1. The United States, an insular power developed in isolation from the quarrels of balance-of-power Europe, harbors the belief that peace is the normal and universally desired condition of mankind. War is abnormal and preparation for war is abnormal.

2. Americans have optimism about progress in human affairs which is easily translated into oscillations of mood between hope (based on illusion) and disenchantment (attending disillusion) when confronted with the intractability of international competition and conflict. Traditionally Americans have solved problems, not lived with them and redefined them as conditions.

3. Americans are prone to personalize international relations. Problems are deemed to be solvable through person-to-person meetings.

4. Persons of goodwill can always reach agreement if they try hard enough. Americans view compromise as the essence of negotiations.

5. Order and stability are values to be promoted and defended internationally. [14]

The American tradition is one of moralism and making virtue out of the bequest of geographic distance from the amoral squabbles of the Old World. Americans are conditioned geopolitically to think and feel in a distinctively American way: the frontier tradition, an experience and expectation of success in national endeavors, an abundance of resources for defense, a dominant political philosophy of liberal idealism, and a sense of separateness -- moral and geostrategic -- from evil doings of the Old World.

Since 1945 that position has not been tenable: the United States emerged from that war as the pre-eminent power and facing the rebuilding of its allies and containment of the perceived threat to its

security: the Soviet Union. The rebuilding and expansion of world markets and the creation of an environment for the guarantee of property rights has brought about a high level of prosperity for itself and its friends and allies. It is not possible for the United States to return to an isolationist position because its economy is too dependent upon virtually all the other world economies.

There is presently a revival of the isolationist vs. interventionist debate. This debate will intensify in the forecast period. In the 1930s and 1940s, this debate focused on keeping the United States apart from matters not directly threatening its tangible interests. Isolationism is the traditional American geopolitical position. The conversion of the isolationists to interventionists was a consequence of war and anticomunism. The neoconservatives of today play the part that in the past was played by the liberal internationalists -- the United States crusade for global democracy (a la Wilson). However, if the results of the Persian Gulf war are not positive, the isolationists would seem better poised to dominate the debate than at any time since Pearl Harbor.

"Isolationism" is an imprecise term. The United States will not be autarkic. Such a position is inconceivable given the reality of American prosperity. However, given the basic optimism of Americans, the lessening of tensions could lead to a feeling of euphoria and desire to "come home and solve America's problems." An accommodation of sorts will occur. The reality of the multi-polar world and the recognition that other nations must be responsible for sharing the security burden will increase the likelihood that the United States will not pursue a "go it alone" policy and be the global policeman. The American electorate will not support such a position indefinitely. The United States will be active in international security affairs, because its interests are international in scope. However, as a new generation of leaders not having experienced World War II assumes power, there will be a very real likelihood of a reinterpretation of America's role in international affairs. Each generation's experience colors its Weltanschauung.

What kind of world will the United States be facing in 2015? Several basic structural changes are taking place. There is a definite shift to the Pacific Rim and away from Europe. The Asian-Pacific Rim is America's largest export market -- \$21 billion larger than Europe in 1989. While the EEC will be a major trading bloc and a primary partner both politically and economically, there will not be a security threat to the United States in Europe. The question is what will the EEC become as a political entity? It has no independent taxing authority, and all decisions must be executed by the national governments. To what extent will the existence of a single market and common value-added tax, common tariffs, labor and security norms and currency force parallel fiscal and economic policies and a practical unification of national policy? For the foreseeable future there are doubts this will occur: it will likely be a powerful association and will be described like the German principalities in the early 19th century: "impregnable in defense and incapable of aggression." [24]

The potential for security concerns in the Pacific Rim area, on the other hand, is high. North Korea is on the verge of becoming another Iraq: the nuclear threat is great. Secretary of Defense Richard Cheney has said that North Korea is the only place in the world where he fears an unprovoked nuclear attack on U.S. forces. The Republic of Korea is not particularly stable politically, and is

acquiring advanced weapons technology.

The Republic of Korea trades (through third parties) with China to the tune of \$3 billion per annum, five times the amount of trade China has with North Korea. Seoul has also developed economic and commercial ties with the Soviet Union. The November 6, 1990 edition of The Wall Street Journal reported direct telephone links between Moscow and Seoul, with 5,000 calls per month. The Republic of Korea also has guaranteed the Soviet Union \$2.3 billion in loans.

A line of "economic force" stretches from Japan to Australia, but will that economic power also become political power? Is political power possible without military power? The refusal of Japan to become actively involved in Operation Desert Storm has raised questions about the "commitment" of the Japanese to the Western Alliance. Yet, Japan has been quite willing to use economic muscle on the political issue of the Northern Territories dispute with the Soviet Union.

Japan has an aging population: over 20% of the population is over the age of 65. The aging phenomenon will not change in the forecast period. It is unlikely that Japan will risk its homogeneity and allow any immigration which could alter its demographic trend. Can an "aged" population develop into a military threat? With the passing of the World-War-II generation from the scene, will the new generation of Japanese leaders be hesitant to develop the nation's military potential? What kinds of threats would Japanese leaders consider sufficient to develop a capability beyond its defense forces?

Japan is vulnerable to changes in the international trading economy and trade discrimination or a trade war. Currently lacking the ambition for a global role, Japan is probably disqualified for it by its historic isolation. Resentments in Asia from World War II and current trading practices, which many Pacific Rim nations consider discriminatory, are obstacles to a world political role commensurate with its economic strength. But, the relative military weakness of Japan and the countries of Europe is reversible: all have been military powers in the past. Increasing Japanese rearmament is within the realm of the possible.

As noted above, China will eventually undergo military modernization. China is an enormous country in both territory and population, leading many to question whether a country of that size can be governed because of regional disparity (the coastal delta with the overwhelming majority of the population is contrasted with the arid center).

Other countries of the region pose similar questions. Indonesia, for example, is politically unstable. Because of the enormous volume of trade conducted with this region, the United States has vital strategic interests in the political events in the Pacific Rim. It is conceivable that any or all of these countries could eventually be perceived as a security threat. How reliable an ally is Japan? When a peace treaty ending World War II eventually is signed between Japan and the Soviet Union, how closely will the two nations interact? How trustworthy is the Republic of Korea? Indonesia is the world's largest Moslem nation. What if a fundamentalist revolution occurs there comparable to that in Iran? What role would the United States play in a war between two of its allies? Would it need to remain neutral? Would it be able to remain neutral? Must the United States consider all these nations potential security threats?

In the forecast period, the United States will be reduced as the focus of power for several reasons:

1) the reduction in great power confrontation (the end of the Cold War) will mean that the United States will no longer necessarily be seen as the "decisive leader"; 2) the rise of Japan as an economic power, particularly in high technology, means that much of the focus of technology will shift there; 3) social problems at home (drugs, crime, aging of the infrastructure, a general perception of a declining quality of life) will require attention to be diverted to the domestic agenda; and 4) the low investment rate and productivity of the American economy will mean that it cannot be the driving engine of the world market. Make no mistake, it will still be vitally important, but not the engine. There will be many engines. [5]

Other geopolitical factors to be considered are demographic change and the tension between global economic interaction and national politics. The aging of the developed world is a fact: populations there are not reproducing themselves. The developing world presents the opposite picture: it is growing at an astonishing rate. Mexico is a clear case: 40 percent of its population is between the ages of 14 and 25. It is typical of the "South". The aggregate population growth rates will probably result in per capita GNP that stagnates or declines in Mexico, Argentina, and Egypt. High unemployment (over 40 percent has been suggested) may pose risks to political and social stability in these countries and adjacent regions. Tensions, instability, and in some cases conflict may arise as a result. The intensive immigration to more developed states from Latin America and Asia to North America, and the Middle East and Africa to Europe has been occurring at a steady rate. Social and political tension in Europe can be seen today and will intensify in the forecast period. Immigration has caused a marked change in the social texture and cultural patterns of the United States. This massive immigration will influence future cohesion and the political capacities of Western industrial nations. [24]

While the economies of the world are becoming increasingly interdependent and economic transactions span the globe on a twenty-four-hour basis, each nation-state has its own national priorities and constituencies. There is a global capital shortage, and the U.S. economy has lost its attraction for capital -- more money has been going out than coming in and this trend could be long-term. Japan's economy is growing faster than that of the United States and the European Community is a capital sponge: the unification into a single market has kept money home for investment. The leverage imposed by the United States on Japan in the past (the threat of closing U.S. markets or removing the security umbrella rings hollow today) is no more. The likelihood of tension between global economic activity and national politics is real. It is likely that the United States will aggressively pursue its economic goals and no longer subordinate them to its security interests. It will require much patience and perseverance on the part of free-traders to maintain the world markets and defuse tensions. The emergence of European, East Asian, and North American trading blocs may foster regional security perspectives--a world with three roughly equal economic powers may have no country willing to take the responsibility for collective security.

It is unlikely that there will be a systems change in international organization. The reasons for the rise of the nation-state in the 17th century have not changed substantially. In spite of the persuasive arguments put forth by the "interdependence" analysts, there are flaws in their arguments. The rules for the open international economic system precede, rather than follow, technological change: the

telecommunications revolution has fostered interdependence of the world's economies, but the markets have been able to develop within a broader institutional structure delineated by the power and policies of the state. Ultimately, the survival of states is enhanced by the growing significance of juridical sovereignty: the fact that they are recognized as sovereign by other states in the international system. Evidence for this can be seen in the drive by nation-states to protect the sovereignty of a state invaded by a neighbor (Kuwait) but not "interfere in the internal affairs" of another state during a popular uprising (civil war in Iraq).

## CONCLUSION

In the year 2015 the world will be multi-polar with different blocs of powers vying for resources and economic supremacy. The United States will still be powerful, but will not be driving the world's economic engine. The United States will work in concert with other trading blocs: Europe, East Asia, and the Western Hemisphere. There will be nation-states in other regions that will be more powerful than their neighbors and the conflicts that arise will require concerted, coalition action by other nation-states.

Threats to security will come in the form of regional conflicts between smaller states and groups within states vying for power. The "misery index" of the "South" will need to be reduced or the developed world will face serious terrorist threats and regional wars. The fissure between rich and poor nations will be a test for the developed world. Few people see poverty as the will of God. The global telecommunications network has revealed that poverty is the result of human decisions. Overcoming the poverty gap will be the most powerful political force of the age. [10] As we noted above, as tribal and national groups attempt to unite with their own kind, they will lunge for tribal turf and national sovereignty. The power of charismatic leaders--Caesars--will be a warning signal of potential difficulty. Political conflicts will arise from religious differences, racial or tribal collisions, language conflicts, or historical antagonisms. These could develop into "we" and "they" confrontations on a global scale. These groups will need to rediscover and reassert pride in their past as a measure of self-esteem. If the United States can assist them in that effort, then potentially lethal conflicts can be averted.

The United States will need to have highly mobile armed forces, well-equipped with high-technology weaponry and highly skilled personnel to operate it. The forces will need to have theater-specific capabilities and be able to respond quickly to perceived threats to American interests. Those interests will be primarily economic in nature: threats to markets and natural resources.

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## CONCLUSION

Two powerful forces--demography and technology--are driving the trends identified in this study. These two forces affect all aspects of the domestic scene and have international impact as well. Technological developments have transformed the industrial order and brought about the post-industrial society, the microelectronic revolution, the information age--whatever one may choose to call this era. These developments have generated domestic and global turbulence fed by broad changes in the size and structure of populations, the distribution of natural resources, particularly those relating to the generation of energy, and the results of technology in all fields.

In the domestic arena, the population trends indicate that the United States is an aging society. While acknowledging that demographic projections are not always reliable (human reproductive behavior is especially volatile), the trends have been very powerful: there is unprecedented decline in fertility rates and an accompanying explosion in longevity. Projections suggest that the fertility rate of the United States will fall gradually to about 1.65 by the year 2015 (a number that is considerably below the 2.2 figure considered replacement level), while in the same period, life expectancy will rise to almost 85 years. Barring a major shift in individual behavior, that trend is very likely to remain unchanged.

What do these demographic trends portend for the United States in 2015? Health care costs will take increasingly large portions of federal, state, and local budgets because older people require more attention. Total health-care spending is currently about 11 percent of GNP and is projected to be 17 percent by 2015. A higher number of workers will retire from the labor force than enter it; fewer workers will be producing for more retirees. A pattern of generational and ethnic conflicts could emerge from this condition. The issues: will increased burdens be borne by workers or retirees benefits be reduced, and will the majority of taxpayers--who will be nonwhite--continue to support non-Hispanic white retirees?

Because the work force will have fewer members yet increasing demands (to compete internationally in order to maintain prosperity, to support retirees, to build for their own and their families' futures), efficiency will be the driver of the economy. In a shrinking manufacturing sector, more robots will perform those tasks requiring intensive labor. The service sector will expand, both because of the transition to a post-industrial economy where the service sector is naturally larger and to meet the increasing services required by the aging population.

Because fewer new workers will be entering the labor market, the United States will need to ensure that every member of society is productive. Society will not be able to afford any "forgotten members." Educational excellence will also be driven by the need to remain competitive in the international arena. Parents and educators alike must expect better quality and demand higher achievement of each child exiting the education system.

The U.S. Army will have a smaller manpower pool from which to select its members. Weaponry will become increasingly complicated and "smart" because of technological advances, and operators will

need to be better qualified. Even with advances in modular assembly, the army will need to rely on personnel who are highly skilled, cognitive-capable problem-solvers. One certainty is that individual initiative and creativity will be ever more critical to success.

Technology and resources will also be driven by the aging population: there will be incentives for "wonder drugs" and bioengineering breakthroughs. The U.S. Army will be forced to rely on increasingly complex sensor technology because more functions will be performed by fewer personnel.

Regionally, the changes in population will bring pressure to bear on natural resource availability and distribution. Water, for example, may determine how much population and agriculture the West and Southwest can support.

The demographic trend indicates that the ethnic composition of the United States is changing. Americans of European descent are not replacing themselves in sufficient numbers to maintain the historical majority in the population. Hispanic-, Asian-, and Black-Americans are increasing at a faster rate than non-Hispanic-white Americans. Maintaining basic consensus necessary for effective public action becomes more difficult when a society divides into distinct and separate ethnic and cultural blocs. The fundamental question arising from this trend is whether the dominant feature of American society will continue to be "pluralistic." Will immigrants assimilate to the point where they have a strong sense of "American-ness" or will they cling to ethnic and racial categories ranging from "Asian-American," "African-American," "Hispanic-American," to "Salvadoran-American," "Vietnamese-American," "Nigerian-American," ad infinitum at the expense of being "American?" The answer depends on whether the immigrant populations refuse or are not allowed to assimilate to the national norm. These are public policy decisions. The results of those decisions will influence the nature of the Army in 2015. No serious problem is foreseen because the Army is one institution that has been more successful than others in dealing with ethnic diversity.

Internationally the "graying of the North" is driving trends as well. Like the United States, the population of the developed world, "the North," is growing at a slower pace. Many nations of Europe have fertility rates lower than that of the United States, and the projection is that the trend will persist. At the same time, the "South," the developing or Third World, is young and rapidly reproducing itself. Global projections predict a population of seven billion by 2010; 84.1 percent of that population will reside in less developed countries by 2025. These are sobering statistics with important geopolitical ramifications.

First, given the aging of the "North," some analysts suggest that the central challenge to the survival of democracy, freedom, and capitalism is demographic decline: there will be fewer free Westerners around to protect and promote these values. If the current movement toward multiparty democracy in Africa and Latin America does not succeed, the "North" will risk being outnumbered.

Second, the intensive migration from the "South" to the "North" will exacerbate social and cultural tensions, creating conflicts. The nature of such conflict is usually expressed in terms of the "push/pull" model: the economic deprivation, unemployment, and high fertility (push) of developing countries work in tandem with the possibility for family reunification, higher wages, and the demand for

employment (pull) in industrialized countries. Another factor on the "push" side of the model that has recently become prominent is environmental degradation. The Haitian "boat people" fled poverty caused, among other things, by soil erosion and deforestation. The environmental consequences of resource destruction brought about by population growth and industrialization is a worldwide phenomenon. In the forecast period, economic, political, and ecological pressures may trigger significant waves of refugees to the developed world.

The influx of immigrants will aggravate differences between peoples, causing social tensions. Natives will fear a change in the political and social complexion of the country, a "minoritization" or cultural pollution. The potential for conflicts will increase.

Third, in periods of turbulence, people tend to grasp "eternal" values such as ethnic unity (tribalism), social cohesion, religious beliefs and practices, and national sameness to maintain their sense of identity. The possible struggles arising from clashes between value systems may be a prominent feature of the next century.

The "South" will not be forever young, however. With development comes the eventual possibility that changes in individual behavior will occur and the demographic trend will be altered. This trend alteration is not foreseen in the forecast period.

The second structural force driving domestic trends is technology. This force drives the demographic parameter through medical developments in family planning and life extension. More women have entered the work force and professions once the exclusive domain of males. This trend will continue because the declining fertility rate will dictate that the United States will need the talents of every member of society. Technological advances in medicine may permit older people to retain their capabilities and be economically productive longer. Bioethical questions will accompany birth control, abortion, and family planning developments and will continue to be divisive social issues.

Technological developments bring to light new fabrication procedures and new materials requiring raw ingredients that the United States has in very limited supply or not at all. Reliable suppliers will be mandatory for U.S. security. This trend will be likely to intensify. How and from which sources the United States meets its needs for resources, particularly mineral fuels, will be a major challenge.

Technology is of fundamental importance to the economy because it is driving global interdependence through telecommunications and data transfer: financial and business transactions are conducted on a 24-hour basis. Global interdependence, however, may lead to attempts by national governments to impose more controls on domestic populations. Shrinking economic, social, and political distances have transnationalized global affairs and increased vulnerability of domestic economies to external influences. National governments, for example, will intervene in the internal flow of goods and services in order to cope with internationalization of market and banking systems. Technology will shape the work place in increasing ways, from information processing and computer-aided design to robotics. Electronics manufacturing will replace steel as the principal measure of an economy's industrial output because it will be the essential component in much that is produced. Operation "Desert Storm" demonstrated that the manufacture of electronic components is already a strategic resource.

Technology is an important driver of education reform and will be the principal factor in the development of distance learning that links remote "learning centers." The use of technology in education will go beyond the imitation of television into interactive learning. The army will need to take more responsibility for the remedial education of recruits. It will be forced into making even greater strides in the development of education technology and its application.

Technology transfer to other nations has been and will continue to be a national security concern. Because of the increasing frequency of co-production schemes and movement of scientific research worldwide, this concern will only intensify. The spread of advanced technology to Third World countries will increase the danger of more deadly conflicts in areas remote to the United States. The Army will need to rely on specialized operations units that will be readily deployable and have theater-specific capabilities.

In consideration of any global view of the future, it is important to take stock of any change in the basics of the human condition, the philosophical underpinnings (teleology, ontology, and epistemology--questions specifically raised by the sponsor). Has there been or is there likely to be any change in our basic relation to the universe?

The short answer is simply no. Despite the incredible progress in science and technology during the past few centuries, and particularly the past few decades, the basic human condition remains the same. The individual, his knowledge of the universe being mediated by his limited senses, is born and dies, relying on faith to provide value to his own life and that of the universe. Whether there is an aim, purpose, and direction to life is still a judgement to be made by every individual. Social progress in the sense of people being able to live together in harmony has not changed throughout recorded history; there have always been oases of sanity, harmony, and riches surrounded by incredible misery and senseless cruelty. The 20th century has seen the likes of Hitler, Stalin, Idi Amin, and Saddam Hussein, and one can argue that the amount of human carnage has not decreased, nor even its percentage, despite our "enlightenment." In terms of human rational faculties, despite their "extension" by infrared vision systems, telescopes, microscopes, and readouts from physical instruments, the basic sources of knowledge remain as they have been since Socrates. Although humans have been quite adept at using deductive knowledge, even incorporating that process in "intelligent computers" as servants and mind amplifiers, humans know no more of the sources of creativity and of inductive reasoning than they did during the time of the ancient Greek civilization.

There is, however, more grit for the mill, and there is some reason to hope for some long-range qualitative changes in the understanding of ourselves and the universe. While epistemology remains unchanged, its subject, knowledge, has not only grown by leaps and bounds undreamed by our ancestors, but has also given us tools for its organization and its rapid further expansion in computers and scientific research enterprises. The tools have grown to the point where they reach beyond the planet, allowing humans to orbit the Earth and land on the Moon, and to send probes beyond the solar system itself.

Personal powers, as far as ontology is concerned, have also been extended beyond the ancients' dreams. Humans routinely zoom around highways far beyond what organic powers would allow, and

possess the ability to fly at supersonic speeds, to speak instantly to almost anyone on the planet by telephone, and to access an incredible wealth of human knowledge.

With regard to teleology, where are we going, and is there purpose to it? What purpose is there in the birth of a baby? It is clear from the fact that we are undergoing rapid change that humanity is still, in fact, in its infancy, and that this is a time of hope, with the promise of future development of a sane society of incredibly powerful and wise individuals. The time scope for fulfillment of this potential promise is, alas, way beyond the year 2015.

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